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ABSTRACT

As part of a cooperative extension service series by the University of Maryland, this publication introduces the identification and control of common agricultural pests that can be found in field and forage crops. The first of the five sections defines "pest" and "weed" and generally introduces different kinds of pests in the categories of insects, weeds, and diseases. Also in this section, pest control methods are introduced. The second section is a tabular listing of plant diseases including "description and damage" and "control and management practices" information. The third section is a tabular listing of insect pests including "description and damage," "life cycle," and "control and management practices" information. The fourth section lists the weeds that compete with field and forage crops in Maryland including the same categories of information as the previous section. The fifth section is a collection of line drawings of these weeds. (MR)

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COOPERATIVE EXTENSION SERVICE • UNIVERSITY OF MARYLAND • COLLEGE PARK, MARYLAND

FIELD AND FORAGE CROP PESTS

MEP 310

U.S. DEPARTMENT OF HEALTH, EDUCATION & WELFARE
NATIONAL INSTITUTE OF EDUCATION

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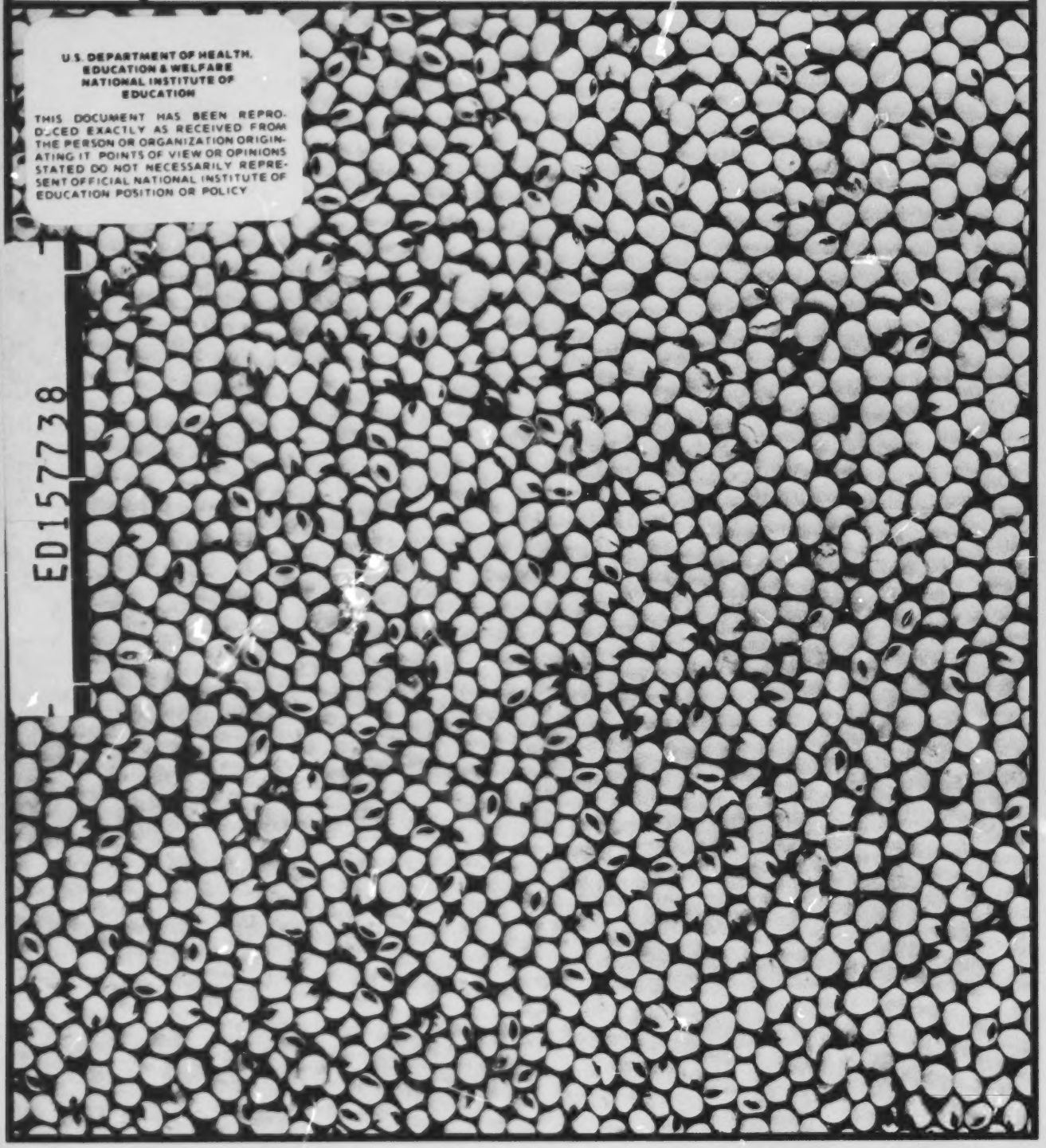

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WHAT IS A PEST?

Plants or animals that are directly detrimental to man or interfere with his goals and interests are commonly called pests. Included are plant and animal diseases, insects (plus mites, ticks and spiders), weeds and vertebrates (mice, some birds, some predatory mammals).

Certain pest organisms are competitors with man while others are simply nuisances or annoyances. A select number of predators, parasites and disease organisms are a serious threat to humans and domesticated animals. Many pests have an indirect influence, such as insects that carry infectious microorganisms. Others are harmful because they interfere with commodity production. They may do damage to a crop or destroy stored products and materials.

Farming practices often aid the establishment of pest species. The one-crop system of agriculture, where susceptible crops are grown and livestock are grazed on the same area continuously over the years, encourages the buildup of certain pests. The pest is provided with a good supply of host plants or animals and can multiply to harmful levels.

Man sometimes moves crops, along with their pest organisms, into new areas. Naurally occurring predators may not be found at this new location, and therefore, the pest is allowed to flourish. In other cases, the natural predators of the pest have been removed.

There are numerous pest species in competition with man, and so far, there are none which he has been able to eradicate completely. Man can only attempt to control these organisms and keep their damage to acceptable levels.

INSECTS

GENERAL

Arthropoda is the largest group in the animal kingdom and includes organisms such as lobsters, crabs, crayfish, millipedes, spiders, scorpions, mites and a special class called insects. This class contains butterflies, bees, ants, flies, aphids, and many more. By pure numbers, the *Arthropoda* are the dominant form of animal life on earth, with millions contained in almost every acre of land. Fortunately, only a small portion are serious pests to man's interests. Insects, as a class, are the most adaptable of all animals. They can be readily found living in the earth's extremes of heat, cold, drought and darkness.

Beneficial species pollinate ornamental flowers and many agricultural crops thus providing us with many of our fruits and vegetables. They work in many specialized areas such as the production of silk and honey, and they also serve as a food source for many higher animal forms.

Some insects pose a real threat to man, either directly or indirectly. The damage to crops, stored products, man-made structures, and the health of man and animals is sometimes tremendous. Many insects can be the vectors of livestock and human diseases while others damage man-made structures or eat foodstuffs. Still others are undesirable because they are a general nuisance to man in his day-to-day activities.

STRUCTURE

An adult insect's body is elongated and divided into three regions, the head, thorax and abdomen. The eyes and antennae are located on the head, and the legs and wings are connected to the middle region, the thorax. All adult insects have six jointed legs, and these are sometimes used for identification purposes since they can vary slightly between species. The adult may have no wings or be equipped with one or two pairs.

Wings and mouthparts are most important in identification. Some insect mouthparts are designed for chewing while others are adapted for piercing a food source and sucking out the nutrient material.

The insect's body is surrounded by a hardened material which not only protects the internal organs but also acts as the insect's skeleton (exoskeleton). Breathing is done through a series of tubes that travel from the body surface to the internal areas, allowing oxygen from the outside to travel directly to the tissues.

GROWTH AND DEVELOPMENT

As an insect matures, it grows in size and often changes form. The rigid shell that covers the body and protects the insect as an exoskeleton will expand only so far. This exoskeleton must be shed at intervals to allow for the growing process. This shedding or "molting" process can occur many times as the organism matures. Before the old shell is cast aside, a new one, which will allow for growth, is already being formed underneath the old.

Insects, between these successive molting processes, are called "instars", and with each molt, the insect will differ in size and form from the preceding instar. This changing process will continue until the adult form is reached. Almost all insects change in shape and size as they mature, and this development process is referred to as metamorphosis.

METAMORPHOSIS

All insects carry on these growth and molting processes, and the successive instars differ in form and size. Some insect species show little variation as they mature, changing only in size. Others undergo an extreme transition where the adult fails to resemble the young insect in any way. This is evidenced by the development of caterpillars into butterflies. Every species follows one of these developmental series of events or a process that falls somewhere between the two.

A small number of insect species develop without any gross changes whatsoever. As they develop, they change only in size. The adult insect lays eggs, and the newly hatched young look just like miniatures of the adult. As the young insects grow, they proceed through a series of molts, maintaining their basic appearance, but increasing in size. Some of these insect species that reach maturity without going through metamorphosis also add additional body segments as they mature. Common examples of these are the silverfish and springtails.

GRADUAL METAMORPHOSIS: Species that are characteristic of this type of development differ from the preceding process in that the eggs hatch into nymphs. The maturing insect (nymph) looks somewhat like the adult all through its development. The nymph is equipped with wing buds which will not fully develop into functional wings until the final molting stage. The mouthparts, legs and antennae are basically the same as the adults. Some nymphs live in water and breathe by gills until they mature. Examples of insects that develop by gradual metamorphosis are cockroaches, grasshoppers, crickets, stink bugs, lice and cicadas.

COMPLETE METAMORPHOSIS: Most of the insects mature by this last growth process. They do not make a gradual change from nymph to adult. The immature and mature forms differ so greatly that one would not believe them to be the same insect, and quite often they live in very different habitats.

Their development proceeds through four stages. A *larva* hatches from the *egg*. In this stage, the insects are referred to as caterpillars, grubs or maggots, and it is at this time that many insects do their greatest damage. The larva shows continued growth and molting and may proceed through several instars. The larva may or may not have legs, and the head may lack development. If the adult is to be winged, the wings will begin to develop internally. At the end of the larval stage, the organism slows its activity and forms a smooth, hard, protective, outer covering and enters into the *pupal* stage. The insect does not feed during this period and is usually inactive. The final molt occurs at the end of the pupal stage, and the *adult* form emerges. Shortly thereafter, colors develop, and the wings expand and harden. Many familiar insects follow this pattern such as maggots to flies, grubs to beetles and caterpillars to moths and butterflies. Other common groups with complete metamorphosis are fleas, wasps, hornets and bees.

Other arthropods can be pests too, such as mites, ticks, spiders, millipedes and scorpions. These insect relatives molt and have other characteristics like insects but none have a pupal stage, nor do any have wings.

WEEDS

When plants grow in undesirable areas, they are referred to as weeds. Common crop plants are considered weeds if they grow and compete in a field that has been seeded for a different crop. Weeds can reduce crop yields, increase production costs and reduce the quality of crop and livestock products. Some are poisonous or cause skin irritation while others are undesirable simply because they reduce the aesthetic value of landscaped areas. The many different weeds fall into four categories according to their life cycles.

SUMMER ANNUALS

Plants of this type have a one-year life cycle and result from seeds that sprout in the spring or summer. These plants mature, produce seed for the next generation and die in one growing season. The seed produced will lie dormant and then germinate during the following spring. Seeds not germinating at this point may do so at a later time when conditions are again favorable. Crabgrass, foxtail and pigweed are summer annuals.

WINTER ANNUALS

Members of this group have a one-year life cycle and grow from seeds that sprout in the fall. They mature, produce seed and die before summer. Their initial growth in early winter may be inconspicuous, but the growth rate increases toward the end of winter, and flowers and seed are produced. The seeds of most winter annuals are dormant during the spring and summer but germinate with the arrival of fall. Some species, whose life cycles are timed with fall-sown grains, produce mature seeds at the time the grain is harvested. The weed seed mixes with the grain, creating problems in marketing. Some representative winter annuals are henbit, field pepperweed, annual bluegrass and chickweed.

BIENNIALS

Biennials have a two-year cycle. When grown from seed, they develop a heavy root and a compact cluster of leaves close to the ground in the first growing season. During the following growing season, they mature, flower, produce seed and die. There are only a few species of biennial weeds, but they may appear anytime during the growing season. Bull thistle is one common biennial.

PERENNIALS

Plants which live more than two years or indefinitely are called perennials. They can grow from seed or from vegetative parts such as tubers, bulbs, rhizomes (root-like stems) or stolons (modified above-ground stems that bend down and take root). Their encroachment into new areas does not completely depend on seed production. Rhizome and stolon pieces can be transported in soil or by equipment. Seed dispersal is the major method of introduction into new areas, and once established, they rapidly spread, often forming patches. Quackgrass, dandelions, plantains and Johnsongrass are examples of perennial weeds.

DISEASES

Any condition that impairs the normal development or execution of normal life functions of a plant or animal is referred to as a disease. These situations are most often brought about by the presence of bacterial, viral, protozoan or fungal pathogens and parasites. Each year, tremendous economic losses can be attributed directly or indirectly to diseases of domestic animals, poultry and crops. Animal diseases reduce production rates and meat value, and some of these infections take on greater importance due to the fact that they can spread to man. Ornamental and crop plants alike are the targets of plant diseases which lower quality and yields. Severe cases of some of these plant diseases can result in complete crop failure.

FUNGI

The fungi are lower forms of plant life and are a very diverse group. They are familiar to us in everyday life as mushrooms, toadstools, molds, mildews, rusts, rots and smuts. They grow and thrive on almost any substance, including such things as water, food, leather, fabric, fibers, paper, glass, plants and animals. Ringworm, athlete's foot and histoplasmosis are just some of the fungal diseases that directly affect man.

Fungi are beneficial in many ways. Their ability to decay plant and animal materials makes them very valuable for maintaining soil fertility. Fungi are used in the manufacture of organic acids, and drugs and in the food industry to produce cheese. Also, some yeasts are used in brewing and baking processes.

Fungi are a lower plant form and lack chlorophyll, the green substance used by higher plants to manufacture their own food. They must live and grow on dead organic matter as saprophytes or on living organisms as parasites. The fungus may kill the host or live and obtain nutrients without causing death.

Of all the parasitic diseases of plants, those caused by fungi are, by far, the most frequently encountered. Almost every plant is subject to infection by at least one type of fungi. In severe cases, quickly spreading diseases can result in crop failure. The devastating Irish potato famine which began in 1845 and the mildew diseases that destroyed the French wine industry from the 1870s to 1880s are examples of the effects of these diseases in agriculture. Not all parasitic fungi have such devastating effects but a variety of them still present a real problem in agriculture and its related activities. A few of the fungal plant diseases that frequently must be dealt with are wheat rusts, potato blights, tomato blights, powdery mildews of rose, lilac, chrysanthemum and other ornamentals, Dutch elm disease, and chestnut blight.

The development of most fungal growths consists of structures which are vegetative or reproductive. In the vegetative stage, the fungus grows on or through the substratum, (the material on which the fungus lives), obtaining nutrient materials by secreting enzymes to break down the cell walls. This vegetative growth may be a single cell or many cells in long thread-like filaments (hyphae). In many cases these hyphae are very difficult to see. As they grow and interlace, they stretch out and attach themselves to new substrate material.

In the reproductive stage, the fungus has the ability to reproduce itself by spores or other means. Compared to vegetative structures, the reproductive structures are much more visible. They develop from the vegetative structures and they differ greatly in form, depending on the genus and species. The common "mushroom" is nothing more than the reproductive portion of a fungus.

Spore formation is the most common method of reproduction in fungi. These are small one-cell units that germinate and form a new plant and are produced in several ways. Millions of spores can be produced by a single fungus and because of this, the surrounding air is more or less filled with spores. These spores can then be disseminated by air currents, splashing rain, insects or other factors. These spores may even be dormant in the soil during periods of unfavorable weather and germinate at a later time.

The factors that play a role in the seriousness of any fungal infection are the number of infecting spores, temperature, humidity, cultural practices, soil moisture and control methods.

BACTERIA

Bacteria are microscopic, single-celled organisms which are so small that many thousands can fit into a drop of water. They can be found everywhere—in air, soil, fresh and salt water, and on plants and animals. Many bacteria benefit man's interests. Some of these organisms decay materials in the soil, making it fertile, while others produce nitrogen in a form useful to plants. Bacteria have been classified and divided into three common forms: rod shaped, oval or sphere shaped and spiral configuration. Most require air for their continued growth but there are some that prefer to exist in the complete absence of oxygen.

Except for a small number that can produce their own carbohydrate food, bacteria survive by obtaining nourishment from the organic materials of plants and animals. Of these, most will grow on decaying plant and animal material while some exist as parasites which attack the living cells of plants and animals.

In a favorable environment, bacterial organisms reproduce themselves readily by the process of cell division. This is achieved by the formation of a crosswall in the cell and two daughter cells result. As this process continues, filaments or colonies are formed. These cells can resist dry conditions and temperature extremes, and some form spores inside when conditions become too unfavorable. Long after the cell is destroyed and more favorable conditions exist, these spores can develop.

Bacteria surround us and when the parasitic forms come in contact with a plant or animal under the right conditions, an infection or disease may result. Ingestion, inhalation or exposure of open wounds are just a few of the ways in which they can attack an animal.

Bacterial plant pathogens can be spread in a number of ways—by wind, water and soil movements, cultural practices, insects or animals. An insect carrying bacteria may feed on a plant and thereby infect the plant. Some bacteria may enter through the water pores and air openings of the plant or simply through wounds. Some may attack the root system also.

Livestock are targets of bacterial diseases such as anthrax, blackleg, brucellosis and mastitis and fowl cholera infects poultry.

The parasitic (pathogenic) bacteria are the causal organism for a wide variety of plant diseases including many spot diseases, wilts, rots, galls and blights. Fire blight and crown gall of fruit trees, wildfire of tobacco, leaf spot of carnations, black twig blight of lilacs, bacteria blight and bacterial wilt of soybeans, fire blight of apples and pears and bacterial wilt of sweet corn are just a few of the plant pathogens.

It is important to remember that some of these destructive diseases are difficult to identify and the symptoms of vastly differing diseases may be similar. After careful study, if a question remains, the advice of an expert might be warranted.

VIRUSES

Viruses are extremely small disease-causing organisms, so small that one must use an electron microscope just to see them. Because of size, their presence is detected only by the symptoms they produce. A particular virus is usually very specific in the type of host in which it infects and multiplies. Also, it will limit itself to one type of tissue. Since the response in the host is usually so specific, viruses are named for the type of disease they produce (hog cholera — hog cholera virus). Viruses are capable of

attacking anything from bacteria to plants and animals. As a cause of much human suffering and considerable losses to the agricultural economy, these pathogens are undergoing intense investigation by scientists.

In crop economic losses, they stand only second to the fungi in importance. Cucumbers, tobacco, sugar beets, corn, fruits, potatoes, asters, elm and beans are just a few of the plants subject to virus infection.

Animal disorders such as foot-and-mouth disease of cattle, hog cholera, Newcastle disease of chickens and rabies and distemper of dogs are all virus caused infections.

Viruses reside in living hosts as opposed to some of the bacteria and fungi that live and grow on decaying material. They must have a living host in order to reproduce themselves and manage to take over control of a host cell and direct it to produce material to make new viral particles. The virus cannot make this material itself. In the process the host cell is destroyed.

Plant viruses are divided into two groups according to the kind of injury they produce. One group, the Mosaics, produce a mottling or a characteristic ring spotting of the leaves. Yellowish spots and blotches make up the disease areas. The second viral type are the yellows, causing dwarfing, leaf curl and yellowing. Mosaics and yellows are responsible for great economic loss in crops, the former taking the greater toll.

Pathogenic plant viruses are spread by a variety of methods. Propagation techniques involving infected seeds, bulbs, roots, tubers or cuttings can allow virus diseases to take hold. Transmission can also occur through the use of contaminated equipment to handle healthy plants. Insects that feed upon plants such as aphids, mealybugs and leafhoppers, can carry the virus from plant to plant while they feed. Pollen, nematodes and fungi can also serve as vectors for virus.

NEMATODES

Nematodes (nemas) are roundworms of various sizes, some being parasitic for man and other animals, while others live on decaying material. The plant nematodes are very small, often microscopic, and are many times referred to as eelworms. Their life cycle includes an egg, four larval stages and an adult. Plant pathogenic nematodes live in soil and for the most part attack roots and other underground plant parts although above ground parts (leaves, stems, seeds) may be the target. As they feed their bodies become enlarged and rounded and swelling may occur in the attacked plant tissues.

Nemas may enter through air openings, water pores or by the wounds that result from mechanical injury. They may merely puncture the surface or enter completely and although the plant may not die, it is left in a weakened condition. As cells are destroyed or damaged, the plant is then left vulnerable to secondary infections by bacteria, fungi or viruses. Organisms of this type are responsible for economic losses in field crops (corn, alfalfa, soybeans, tobacco, etc.), vegetable crops (tomatoes, carrots, etc.), ornamentals and many turf varieties.

PLANT DISEASES

A plant disease may be described as any condition that interrupts the normal development of a plant by altering the appearance or function. Disease conditions may adversely affect the growth habit (stem, branches, roots), leaf shape and size, flowering and fruiting characteristics and all internal plant processes.

The causes of plant disease can be separated into two basic groups, the parasitic and the nonparasitic forms. The nonparasitic ones are classified together because they are all brought about by some unfavorable growth condition for the plant. Typical of the undesirable conditions are deficiencies or excesses in water or nutrient material, improper light, temperature extremes, mechanical injury and undesirable chemicals in the air and soil. Included in the parasitic group are those diseases caused by bacteria, fungi, nematodes (nemas) and viruses.

These parasitic organisms can be found on the interior or exterior of the plant, and the severity of infection will depend on the virulence of the disease and the plant's resistance. In most cases certain temperature and moisture conditions are required for infection, so therefore, climate plays an important role. Some disease organisms flourish only during rainy periods just as others cannot survive the extremes of cold.

Disease organisms must be able to overwinter in order to be able to infect plants during more favorable conditions. To do this, they may form resistant spores, or they may overwinter inside the host plant. Some may find protection in the seeds of plants while others may survive the winter in the tissues of an insect vector. Whatever the system, the life cycles of these parasitic organisms are all different and may vary from the extremely simple to the very complex.

Parasitic plant diseases are given a general classification by the types of visible symptoms they produce. They can be referred to as leaf spots, wilts, smuts, cankers, blights, blotches, rots and mildews.

SPOT DISEASES:

The spot diseases are recognized as a mark or blotch of discoloration found on the foliage or stem of the infected plant. They can be caused by numerous types of fungi and the accompanying environmental conditions. Each spot disease has a characteristic color and many are arranged in concentric rings. Each has a typical size and shape and in some cases, the disease affected area may also fall out forming a hole in the leaf. Certain insects may cause spotting of leaves.

WILT DISEASES:

Wilt conditions can be caused by a number of agents. Wilting may be due to a water deficiency or because of pathogens such as bacteria and fungi. In most cases, there has been a blockage of the water conducting system of the plant due to disease or mechanical injury.

DAMPING-OFF:

Any of several fungi can cause this rotting of seedlings and cuttings. Seedlings may be attacked after germination but before they break through the soil. Postemergence attack can also occur, resulting in the killing of roots and stems at the soil surface. As cells are destroyed the plant weakens and falls over.

SMUTS:

These diseases are called smuts because of the sooty-black masses of spores that they produce. The target of the infections are usually the heads of corn and other cereal crops. The cause of the diseases are the true smuts fungi of the order Ustilaginales. The powdery masses break into dust-like powder when disturbed and the spores are then dispersed by the wind. Many of the fungi enter the host plant at an early stage of the plant's development and grow with it until the plant reaches maturity.

RUSTS:

Although this name is commonly applied to many ailments resulting in reddish-brown spotting or color change in plants, it is most accurately used to describe infections caused by fungi of the family Uredinales. They must reside on living plants and grow internally. The fungus penetrates cells and then removes the cell's nourishment.

ROTS:

Any large-scale decay of living plant material by an organism may cause rot. The name "rot" is used to describe many conditions which are caused by bacterial or fungal infestations.

BLIGHTS:

This is a commonly used term describing diseases occurring because of attacks of bacterial, fungal or viral parasites. Undesirable climatic conditions are also a contributing factor. The target area is usually the young growth of a plant, and the end result is withering and general death of stems, leaves and flowers.

BLOTCHES:

General terminology such as this is used to describe diseases that arise from any of a number of plant pathogens. Usually, it is referring to the appearance of the diseased area. A plant with a blotch disease has infected areas that are irregular in size and shape, which separates them from the spot diseases.

CANKERS:

An area of diseased woody tissue is often described in this way. Infestation by any parasite or damage by other factors results in the shrinking and cracking of tissues, leaving an open wound.

MILDEW DISEASES:

Plant pathogens of this type are evidenced by fungal growth that form on the surface areas of a plant, such as the leaves and stems. It may appear white, gray, downy or powdery, giving rise to such names as "downy mildew" or "powdery mildew". The severity of tissue infection is dependent upon the type of fungal organism.

MOSAIC DISEASES:

Many virus diseases are given this name because of the mosaic-like appearance of diseased leaves of the host plant. The leaves are mottled with light and dark areas and may show wilting and curling.

PEST CONTROLS

Man can encounter a wide variety of pest problems associated with his daily activities and interests. Whether they be diseases or unwanted plants and animals, the success of the control measures will depend on the use of a logical approach to the problem. The pest must first be identified. Knowing the characteristics of the pest organism and the crop or animal being threatened results in the choice of good control and management practices. The available control methods, including their risks and benefits, must be considered. The methods must be chosen that will be most effective and cause the least harm to the environment.

With most pest problems a condition arises, symptoms are analyzed, and then some type of corrective action is taken. However, not all pest problems can be attacked by this method. The approach to plant disease problems is one that differs in that the control is based primarily on prevention of the disease condition. In many cases, once the plant disease is recognized, it is too late for proper treatment.

There are control procedures available for treating pest problems and the degree of effectiveness depends on the type of problem and the severity. The following are the most important control methods.

NATURAL CONTROLS

A natural control is any ordinary condition in nature that slows down the reproduction and growth rates of pest species. Weather factors, such as moisture and temperature, are major control forces of insect and plant disease problems. Predatory and parasitic insects and some birds destroy many insect pests. Virus, fungus and bacteria diseases also take their toll among insects.

BIOLOGICAL CONTROLS

Biological controls involve man's use of natural predators, parasites, diseases and breeding techniques to reduce the numbers and economic impact of pest species. By releasing natural enemies, man can help control the pest. Aphid-parasitizing insects, one fungus antagonistic to another, and nematode-trapping fungi are all examples of biological controls.

Varieties of plants, which strongly resist disease and insect pests, have also been developed by man.

Another technique being used is the release of sterile male insects, causing interference in normal insect reproductive behavior.

PHYSICAL AND MECHANICAL CONTROLS

Physical controls are sometimes the most effective measures and include anything from fly swatters to ultra-high frequency sound production for killing pests. The use of radiation, distress and mating calls, repellents such as reflective "mulches", steam soil sterilization, and the various light, bait and sticky traps are all physical control methods. Other methods are electric shock grids, barriers, filters and fences for pest control. Habitat manipulation may involve flooding, drainage and nesting site destruction. Basic control measures for weeds are cultivation and the cutting of top growth to reduce weed vigor.

CULTURAL CONTROLS

Planting, growing, harvesting and tilling practices are all part of the cultural control of pests. Additional cultural control practices are crop rotation, construction methods, timing of planting and proper fertilization. With a knowledge of the pest, one can combine cultural controls with physical and mechanical practices to disrupt the normal association between a pest and its host.

Crop rotation can prevent the buildup of a pest population that favors one kind of plant. Some plant pathogens are unable to survive when a certain host is not present. Planting an alternative crop on which the parasite cannot exist will reduce parasite numbers after a time. The vulnerable crop can then be grown again.

Proper cultural practices, such as correct fertilization, will prevent certain diseases by producing vigorous plants. The removal of diseased plants and plant parts is very helpful in controlling diseases. Planting, tilling and cutting sequences are also a factor. The planting of crops in early spring before germination of weed seed will help avoid summer-annual weed problems. Insect pests can sometimes be controlled by carefully timed plowing which destroys a certain insect life stage.

CHEMICAL CONTROLS

Chemicals are used in a number of ways to control pest populations. They may be used to kill pests or they may act indirectly in the control method as repellents, attractants, sex stimulants, hormones or plant-growth regulators. The primary advantage of chemicals is speed in controlling pest problems, but in many cases their value is in protecting the host from possible disease infestations.

Pesticides and their related products come in many formulations. Most common are the emulsifiable concentrates, wettable powders, granules, aerosols (smokes, fogs, steam, vapors, etc.) baits (lures), dusts and impregnated materials.

Chemical control materials can be absorbed by pests in many ways. With contact absorption, the pest organism is adversely affected when it touches the pesticide. Plants can absorb herbicides through foliar (leaf) or root absorption. In the case of animal pests, some chemicals must be ingested before they take effect.

Some pesticides are referred to as systemics because they must be taken up and retained by the host. They render the potential plant or animal host toxic to pests feeding on it. The systemic may inactivate disease-produced toxins or directly attack the pest organism.

Certain chemicals act as pest repellents while others act as inhibitors of normal plant activity. Some weeds are controlled by photosynthetic-inhibiting herbicides which reduce weed vigor. Preemergence herbicides kill weed seedlings before or soon after they break the surface.

Other materials are referred to as chemical attractants and are used to lure insect pests to areas where they can be killed. These "pheromones" can be of an assembly-aggregation type or a sex attractant-sex stimulant type.

INTEGRATED CONTROLS

Often a combination of control methods is needed to achieve the desired effect. Combinations of bio-cultural controls, bio-physical controls and cultural-physical controls are very common.

When pests threaten, there are three basic approaches available to meet the problem.

PREVENTION: Steps can be taken to avoid infestations. Inspections and quarantines will help keep pests from infesting new areas. Clean conditions, cultural controls, treated seed, resistant varieties and pesticides all help to prevent problems.

SUPPRESSION: Once pest infestations have occurred, steps must be taken to reduce their numbers to acceptable levels. Chemical, cultural, physical and biological controls all help reduce the pest populations to keep damage to a minimum.

ERADICATION: In some cases, it is necessary to press control procedures even further to include the complete destruction of a pest in an animal or a crop area. Removal or destruction of diseased parts, or sterilization and fumigation of soil are examples of this total approach.

PLANT - DISEASE INDEX

ALFALFA *(Medicago sativa)*
- Anthracnose
- Bacterial wilt
- Damping-off
- Dodder
- Downy mildew
- Fusarium root rot
- Leaf rust
- Leaf spots and Leaf blotches
- Root rot
- Sclerotina crown rot and Stem rot
- Spring black stem
- Virus, mosaic

BARLEY *(Hordeum spp.)*
- Covered smut
- Leaf blotch and Glume blotch
- Leaf rust
- Loose smut
- Nematode injury
- Net blotch
- Powdery mildew
- Root rot and Crown rot
- Scab (Fusarium blight)
- Scald
- Spot blotch and Seedling blight
- Yellow dwarf

CLOVERS *(Trifolium)*
- Anthracnose
- Damping-off
- Dodder
- Fusarium root rot
- Leaf spots and Leaf blotches
- Powdery mildew
- Root rot
- Sclerotina crown rot and Stem rot
- Virus, mosaic

CORN *(Zea)*
- Anthracnose
- Bacterial wilt (Stewart's wilt)
- Downy mildew (Crazy top)
- Helminth leaf spot
- Leaf rust
- Nematode injury
- Northern leaf blight
- Root rot, Stalk rot and Ear rot
- Seed rot and Seedling blight
- Smut
- Southern leaf blight
- Storage rot
- Viruses
- Yellow leaf blight

OATS *(Avena)*
- Covered smut
- Helminthosporium blight
- Helminthosporium leaf blotch
- Loose smut
- Powdery mildew
- Scab (Fusarium blight)
- Septoria leaf blotch
- Yellow dwarf

RYE *(Secale cereale)*
- Ergot
- Helminthosporium blight
- Leaf rust
- Leaf scald
- Powdery mildew
- Scab (Fusarium blight)
- Septoria leaf blotch
- Yellow dwarf

SOYBEANS *(Glycine max)*
- Bacterial pustule
- Bacterial wilt or Bacterial blight
- Brown spot
- Brown stem rot
- Bud blight
- Downy mildew
- Frogeye leaf spot
- Phytophthora root rot
- Pod blight and Stem blight
- Purple stain
- Root knot
- Root rot

WHEAT *(Triticum)*
- Bunt or Stinking smut
- Helminthosporium blight
- Helminthosporium leaf spot
- Leaf blotch and Glume blotch
- Leaf rust
- Loose smut
- Nematode injury
- *Ophiobolus graminis* and other fungi
- Powdery mildew
- Root rot and Crown rot
- Scab (Fusarium blight)
- Sooty mold
- Yellow dwarf

DISEASE	DESCRIPTION AND DAMAGE	CONTROL AND MANAGEMENT PRACTICES
ANTHRACNOSE *(Colletotrichum* sp.*)*	Alfalfa and Clovers Fungus which is favored by hot, moist weather. Dead, straw-colored stems scattered throughout the field. A "shepherd's crook" is often observed in young dead shoots. Diamond-shaped lesions with a dark border appear on the lower part of stems and may girdle them. Crown buds and the crown may also be killed, resulting in stand thinning.	Avoid planting extremely susceptible varieties such as Saranac. Iroquois is also susceptible. Team, Arc and Saranac AR are resistant.
(Colletotrichum graminicolum)	Corn Small, round or irregular, water-soaked spots first appear on any part of leaf blade. These enlarge and become brown in the center with a reddish-brown border. Leaves shrivel and die.	Use the more resistant varieties. Practice crop rotation and sanitation (destruction of crop debris, clean plowing, etc.). Keep fertility well balanced. Where appropriate, such as on seed corn, fungicides may be applied.
BACTERIAL BLIGHT	Soybeans (See BACTERIAL WILT — Soybeans)	
BACTERIAL PUSTULE *(Xanthomonas phaseoli* var. *sojensis)*	Soybeans Bacterium which lives from year to year in infested residue and on seeds. Small yellow green spots with reddish-brown centers on the upper leaf surface. Presence of a small raised pustule in the center of each spot, especially on the lower leaf surface. Tissue may fall out, giving the leaf a ragged appearance. A warm weather disease, occurring in August and September.	Use resistant varieties which include Essex, Williams, Dare, Hood, Lee and Clark 63.
BACTERIAL WILT *(Corynebacterium insidiosum)*	Alfalfa Bacterium in the soil which enter the roots through wounds. Plants become severely stunted and have many yellow shoots with small, cupped leaves. When roots are cut, a yellowish or brownish ring is evident under the bark. If the bark is peeled back, the disease appears as streaks in the outer woody tissue.	Where an alfalfa stand is desired for three or more years, use of resistant varieties is the only answer. These include Vernal, Saranac, Iroquois and commercial varieties (DeKalb 123, DeKalb 163 and Pioneer 520). DuPuits is very susceptible. Rotating fields to other crops for two or more years will help. Control root feeding insects.

DISEASE	DESCRIPTION AND DAMAGE	CONTROL AND MANAGEMENT PRACTICES
BACTERIAL WILT (Stewart's wilt) *(Erwinia stewartii)*	Corn Bacterium which are transmitted by the corn flea beetle. Occasionally serious in Maryland. Field corn not as susceptible as sweet corn. Long, irregular pale green to yellow streaks occur in the leaves. The streaked areas die and become straw-colored. Plants may appear stunted. Entire leaves may dry up, reducing yield. Plants more susceptible to stalk rot.	Use of the more resistant varieties. Early applications of insecticide to control corn flea beetles. Disk or plow under trash.
BACTERIAL WILT or BACTERIAL BLIGHT *(Pseudomonas glycinea)*	Soybeans Bacterium that are seed-borne and also overwinter in dead leaves. Leaves show numerous small, angular spots which turn yellow then brown. Large areas of the leaf may fall out, giving the plant a ragged appearance. Leaves may fall prematurely. Most severe during wet, cool weather. Occurs as a spot on leaf with light brown dead areas surrounded by yellow halo.	Do not plant seed harvested from infested fields. Do not plant disease-free seed in a field with a history of the disease. Seed treatments of little value. Use resistant varieties Dare, Hood.
BLOTCHES	Alfalfa and Clovers (See LEAF SPOT — Alfalfa and Clovers)	
BROWN SPOT *(Septoria glycinea)*	Soybeans Fungus which is seed-borne and overwinters in infected crop residue. Appears on lowest leaves in June and July as angular reddish-brown spots. Trifoliate leaves, stems and pods become infected. Leaves turn yellow and defoliation occurs from the bottom of the plant upward.	Crop rotation. Do not use soybeans from infested fields for seed.

DISEASE	DESCRIPTION AND DAMAGE	CONTROL AND MANAGEMENT PRACTICES
BROWN STEM ROT *(Cephalosporium gregata)* *(Phialophora gregata)*	Soybeans Soilborne fungus which lives in infected crop residue. About a month before harvest, tissue between leaf veins turns brown and dries rapidly. Tissues near the veins remains green a few days longer. Infected areas in a field will appear brown in contrast to normally maturing plants. Severely infected plants may lodge. The lower stem of infected plants will be brown in the center compared to a white center in healthy stems.	Practice a 3 or 4 year crop rotation with crops other than alfalfa or red clover. Avoid use of excessive nitrogen. Resistant varieties are not available.
BUD BLIGHT	Soybeans Tobacco ringspot virus, transmitted by grasshoppers, thrips and nematodes. Has a wide host range including several legumes and common weeds. In a young plant, the tip of the stem curves down, becomes brown and brittle. The youngest leaf often develops a rusty flecking. The plant is dwarfed and produces virtually no seed. Plants remain green at harvest in contrast to healthy mature brown plants.	Plant virus-free seed. Avoid high concentrations of cultivated wild legumes (alfalfa, red clover, white clover, sweet clover, common weeds (morningglory, pigweed, dandelion, horsenettle, ragweed and sunflower) in adjacent fields. Volunteer soybeans should also be destroyed.
BUNT or STINKING SMUT *(Tilletia caries,* *Tilletia foetida)*	Wheat Found after wheat has headed plants, grayish green. Smut takes place of seed and is brown. Plants may be dwarfed. Odor of trimethylamine present in field.	Seed treatment and use of resistant varieties.
COVERED SMUT *(Ustilago hordei)*	Barley Fungus carried on kernels and under the hulls. Smut masses replace grain and glumes of barley heads. All or only a few heads of a plant may be infected. Spores are covered by a grayish membrane that prevents wind from dislodging them. The spores, however, are released at harvest and may attach to the kernels.	Use a seed treatment.
	Oats (See COVERED SMUT — Barley)	Seed treatment; use resistant varieties.

DISEASE	DESCRIPTION AND DAMAGE	CONTROL AND MANAGEMENT PRACTICES
CRAZY TOP	Corn (See DOWNY MILDEW — Corn)	
CROWN ROT	Barley (See ROOT ROT and CROWN ROT — Barley)	
DAMPING-OFF *(Pythium, Fusarium, Rhizoctonia)*	Alfalfa and Clovers Caused by several soil fungi such as *Pythium, Fusarium* and *Rhizoctonia*. Found in new seedings. Young plants may be girdled at the soil line, shriveled and blighted. Some plants are killed before coming through the soil. This results in a sparse stand.	Seed should be fully mature when planted. Treat seed. Improve soil drainage where possible.
DODDER *(Cuscuta arvensis)*	Alfalfa and Clovers Parasitic plant. Found on most forage legumes. Plants covered with bright yellow strands. May involve whole fields.	Rotation with crops not attacked for several years.
DOWNY MILDEW *(Peronospora trifoliorum)*	Alfalfa Fungus disease. New growth shows pale-green to yellow blotches, and leaves may roll or twist downward. A grayish, cottony growth of the fungus may be seen on underside of the leaflets. Favored by cool, moist weather.	Cut early to save as many leaves as possible when the disease is severe.
(Peronospora manshurica)	Soybeans Fungus disease. Indefinite yellow-green areas on the upper leaf surface that soon become brown spots. A grayish mold growth occurs on the underside of the leaf. Infected leaves may fall early. Seeds may be covered with a white crust of fungus spores.	Use resistant varieties which include Kent, Dare, Essex and York.

DISEASE	DESCRIPTION AND DAMAGE	CONTROL AND MANAGEMENT PRACTICES
DOWNY MILDEW or CRAZY TOP *(Sclerophthora macrospora)*	Corn This fungus disease not common in Maryland. Corn tassel may be composed of a large, plume-like mass of short leaves (called "crazy top"). Plants are stunted, tiller excessively and have narrow strap-like leaves with whitish stripes. Leaves may roll and twist. Downy growth of fungus may occur on both leaf surfaces. Stalks may be barren.	Where possible, avoid planting in low wet areas likely to be flooded after seeding. Destroy infected crop debris. Remove and destroy infected plants as they appear.
EAR ROT	Corn (See ROOT ROT — Corn)	
ERCOT *(Claviceps purpurea)*	Rye Fungus disease. The first evidence of infection of flowering head is the presence of insects feeding on sugary droplets. Later, a purplish growth grows out of the flowers. The mature growth may be banana shaped.	Remove the purple structures from seed. Control weed grasses.
FROGEYE LEAF SPOT *(Cercospora solina)*	Soybeans Occurs as grayish spot surrounded by reddish margin; later in season also may infect stem, pod and seed.	Use resistant varieties Kent, Lee, Hood and Bethel.
FUSARIUM BLIGHT *(Fusarium spp.)*	Barley Rye Oats Wheat (See SCAB — Wheat)	

DISEASE	DESCRIPTION AND DAMAGE	CONTROL AND MANAGEMENT PRACTICES
FUSARIUM ROOT ROT *(Fusarium spp.)*	Alfalfa and Clovers Disease fungi found in the soil. Leaves of infected plant curl at the edges, then wilt. Dead areas occur in the outer portion of the branch roots and tap root, often in association with wounds. When the tap root is cut open lengthwise, it is discolored brown to black. The tap root is usually completely rotted in dying plants. Stand thinning occurs. This disease is often worse following severe winter heaving.	Maintain good cultural practices to avoid stress on the plants. Do not cut too often or too close. Avoid damage to roots and crown by cultivation practices. Control root feeding insects. Rotating crops is of little value.
GLUME BLOTCH	Wheat (See LEAF BLOTCH — Wheat)	
HELMINTH LEAF SPOT *(Helminthosporium carbonum)*	Corn Fungus infection. Tan, oval to circular spots (½ x 1 inches) that may have a target appearance. May cause black, "felty" mold over kernels.	Use the more resistant varieties. Practice crop rotation and sanitation (destruction of crop debris, clean plowing, etc.). Keep fertility well balanced. Where appropriate, such as on seed corn, fungicides may be applied.
HELMINTHOSPORIUM BLIGHT *(Helminthosporium victoriae)*	Oats Seed-borne and persists on crop residue. Not a problem in Maryland. Early symptoms are reddening and death of seedling leaves. Root and crown rot progress during the growing season. Some leaf spotting occurs during late stage of plant development.	(See NET BLOTCH — Barley) Resistance in Clintland 64 and Garry.
HELMINTHOSPORIUM BLIGHT	Rye (See SPOT BLOTCH and SEEDLING BLIGHT — Barley) Wheat (See SPOT BLOTCH and SEEDLING BLIGHT — Barley)	

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DISEASE	DESCRIPTION AND DAMAGE	CONTROL AND MANAGEMENT PRACTICES
HELMINTHOSPORIUM LEAF BLOTCH *(Helminthosporium avenae)*	Oats Caused by a fungus which may be seed-borne and carried on crop refuse. Blotches, generally on the leaf blade, are oblong and light reddish-brown with an irregular margin. Spots frequently have a sunken center. Leaf blades turn yellow and dry out.	Rotate with legumes. Plower under infected stubble. Plant the more resistant varieties. Barsoy, Jefferson, Knob and Rapidar have some resistance. Use fungicide-treated seed.
HELMINTHOSPORIUM LEAF SPOT *(Helminthosporium tritici-vulgaris)*	Wheat Fungus disease. Spots on leaf blades and sheaths which are yellowish-brown to dark-brown and frequently show zones. The spots spread and cause the leaf to turn yellow, then brown. This disease usually is present but of minor importance.	Destruction of crop residue. Use a seed treatment.
LEAF BLOTCHES	Alfalfa and Clovers (See LEAF SPOT — Alfalfa and Clovers)	
LEAF BLOTCH and GLUME BLOTCH *(Septoria passerinii)*	Barley (See LEAF BLOTCH and GLUME BLOTCH — Wheat)	(See LEAF BLOTCH and GLUME BLOTCH — Wheat) The varieties Barsoy, Jefferson and Knob have some resistance.
LEAF BLOTCH and GLUME BLOTCH *(Septoria tritici, Septoria nodorum)*	Wheat Caused by fungi that overwinter on infected wheat stubble. Also known as "Speckled leaf blotch." Leaf blotch appears as light-green or yellow spots between leaf veins, which spread rapidly to form light-brown, irregular blotches. Tiny dark dots can be seen in the blotches. Spots on glumes are smaller and oblong. May also cause heavy damage on barley.	Crop rotation. Plow under crop residue and destroy volunteer wheat.

DISEASE	DESCRIPTION AND DAMAGE	CONTROL AND MANAGEMENT PRACTICES
LEAF RUST *(Uromyces striatus)*	Alfalfa Rust spots occur mostly on undersides of leaf as small round raised masses of dark reddish-brown spores in the fall.	Use resistant varieties. Cherokee is resistant.
(Puccinia hordei)	Barley Fungus *Puccinia hordei* is easily spread by windblown spores. Orangish-red (rusty) pustules or eruptions on leaf blades. Heavily infected leaves die prematurely.	Plant resistant varieties. The varieties Hanover, Jefferson and Rapidan have some resistance to some races.
LEAF RUST *(Puccinia sorghi)*	Corn Fungus disease. Small, yellowish-orange to reddish-brown pustules on both leaf surfaces. If numerous, leaves may be killed prematurely. Rarely troublesome in Maryland.	None usually required. Use the more resistant varieties.
LEAF RUST *(Puccinia recondita secalis)*	Rye Fungus disease. (See LEAF RUST — Barley)	
LEAF RUST *(Puccinia recondita)*	Wheat Fungus disease. (See LEAF RUST — Barley)	(See LEAF RUST — Barley) The varieties Abe and Arthur have some resistance.
LEAF SCALD	Rye This disease causes less damage on rye than on barley. (See SCALD — Barley)	(See SCALD — Barley)

DISEASE	DESCRIPTION AND DAMAGE	CONTROL AND MANAGEMENT PRACTICES
LEAF SPOTS and LEAF BLOTCHES *(Pseudopeziza, Leptosphearulina, Stemphylium* and other fungi)	Alfalfa and Clovers Caused by several different fungi, the most common being *Pseudopeziza* (common leaf spot), *Leptosphearulina* (Lepto leaf spot) and *Stemphylium* (target spot). A number of fungi cause spots on leaflets. Common leaf spot has very small, round, brown to black spots on the leaflets. Leaves turn yellow and drop as disease progresses. Develops during moist periods at moderate to cool temperatures. Lepto leaf spot has small brown spots on leaflets surrounded by a halo. These enlarge and become irregular with a brown border and tan center. Leaves are killed and cling to the stem for a short time. Greatest damage occurs on young growth after clipping, if moist weather conditions occur. Target leaf spot has oval or irregular spots that appear sunken. These are usually dark brown with a light center. Older spots resemble a target. A single large spot may cause a leaf to drop. Favored by warm, moist weather. This diesease may cause severe defoliation.	Plant recommended varieties. Team has Leaf spot resistance. Saranac is moderately resistant to common leaf spot while Vernal, Williamsburg and Iroquois are moderately susceptible. Cut early when the disease is severe to minimize foliage loss.
LOOSE SMUT *(Ustilago nuda, Ustilago nigra)*	Barley Caused by two fungi. Smutted heads emerge before healthy heads. Smut replaces entire head of plant. Spores are dry and easily scattered by the wind to healthy heads starting new infections. At harvest, only the bare, white central stem of the head remains.	The varieties Barsoy, Hanover, Jefferson, Knob, Pennrad and Rapidan are all susceptible. Use smut-free (certified) seed. Use a seed treatment.
LOOSE SMUT *(Ustilago avenae)*	Oats Caused by a fungus. (See LOOSE SMUT — Barley)	(See LOOSE SMUT — Barley) The variety Compact has good resistance.

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DISEASE	DESCRIPTION AND DAMAGE	CONTROL AND MANAGEMENT PRACTICES
LOOSE SMUT *(Ustilago tritici)*	Wheat Fungus infection. (See LOOSE SMUT — Barley)	(See LOOSE SMUT — Barley) The varieties Abe and Arthur have some resistance, while Redcoat is susceptible.
NEMATODE INJURY	Barley Microscopic eel worms that live in the soil and feed on plant roots. Not serious in Maryland. Stunted and yellowish plants in scattered areas in the field. Root system may have knots or galls, appear "stubby" or be sparse with very few feeder rootlets.	Avoid replanting area with cereal crops. Soil fumigation.
	Corn Many species of nematodes (ell worms) feed on corn roots. Not serious in Maryland. Stunting and a general lack of vigor. Dark, discolored areas on the root system. Root system that appears "stubby" or has few or no branch rootlets. Wilting on bright sunny days. Yellowing, similar to nitrogen or iron deficiency. Uneven height of plants, usually in irregular spots in the field.	Practice crop rotation. Have soil analyzed to determine kind and number of nematodes present. See under "Nematodes" for method of collecting soil and root samples for nematode detection. Submit sample to your county agent. Use chemical soil treatment when recommended on basis of the test.
	Wheat (See NEMATODE INJURY — Barley) Not serious in Maryland.	
NET BLOTCH *(Helminthosporium teres)*	Barley Fungus *Helminthosporium teres* overwinters on old stubble. Chocolate-colored blotches at tips of seedlings leaves. Blotches take on a distinct "net-like" pattern on older leaves, sheaths and glumes. May later become irregular stripes extending the length of the leaf.	Rotate with legumes. Plow under infected stubble. Plant the more resistant varieties. Barsoy, Jefferson, Knob and Rapidan have some resistance. Use fungicide-treated seed.

DISEASE	DESCRIPTION AND DAMAGE	CONTROL AND MANAGEMENT PRACTICES
NORTHERN LEAF BLIGHT *(Helminthosporium turcicum)*	Corn Fungus infection. Very large (1½ x 6 inches) grayish-green or tan spots found first on lower leaves. The disease progresses upward until nearly all leaves are heavily infected. Plant appears as injured by drought. A grayish or black "fuzz", often "target-shaped", appears in the spots during moist weather. Ears not infected.	Use the more resistant varieties. Practice crop rotation and sanitation (destruction of crop debris, clean plowing, etc.). Keep fertility well balanced. Where appropriate, such as on seed corn, fungicides may be applied.
OPHIOBOLUS GRAMINIS and other fungi	Wheat Appear about heading time, but may occur at any time. Small circular areas may appear in fields. Growth is checked. Areas may be brown. Dry rot occurs on basal culm tissue, crown and roots. Fungus may be present on dead tissue.	Crop rotation with legumes.
PHYTOPHTHORA ROOT ROT *(Phytophthora megasperma* var. *sojae)*	Soybeans Soil-borne fungus which may survive in the soil or in crop refuse buried in the soil. Plants of all ages may be infected, but young plants are most susceptible. On young plants, the stems show a soft rot. On older plants leaves turn yellow and wilt. A dark brown lesion occurs on the stem and may extend for several inches above and below the soil line. Taproot is usually dark brown and root system may be rotted. Most common in low, poorly drained areas of the field.	Use resistant varieties which include Cutler 71, Essex, Dare, Clark 63.
POD BLIGHT and STEM BLIGHT (Mouldy Bean) *(Diaporthe phaseolorum* var. *sojae)*	Soybeans Fungus disease which is seed-borne and also overwinters on infected refuse. As plants near maturity, numerous small black fruiting bodies (called pycnidia) occur scattered over pods and in rows on stems. Seedlings grown from infected seed may damp-off shortly after germination. Favored by prolonged periods of wet weather late in the season.	Use disease-free seed (or treated seed). Plow under crop refuse and practice crop rotation to prevent build-up of the fungus. Resistant varieties include York, Wayne, Essex, Williams, Wye, Kent, Delmar and Bethel.

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DISEASE	DESCRIPTION AND DAMAGE	CONTROL AND MANAGEMENT PRACTICES
POWDERY MILDEW *(Erysiphe graminis)*	Barley Fungus disease. Grayish-white, powdery spore masses develop on leaves, leaf-sheaths and heads. Plants appear to have been dusted with talcum. Yellowing, browning and death of leaves may follow.	Clean plowing and crop rotation help reduce the disease. Avoid over-fertilization with nitrogen since heavy, succulent growth favors mildew. The varieties Barsoy, Hanover, Jefferson, Knob, Pennrad and Rapidan have resistance.
(Erysiphe polygoni)	Clover, Red Fungus grows over surface of leaf as a light grayish mat. Leaflets turn brown and die. Found mostly in fall during dry weather. Disease not severe in Maryland.	Use resistant varieties.
(Erysiphe graminis avenae)	Oats Caused by a fungus. Not serious in Maryland. (See POWDERY MILDEW — Barley)	(See POWDERY MILDEW — Barley)
(Erysiphe graminis secalis)	Rye Fungus disease. (See POWDERY MILDEW — Barley)	(See POWDERY MILDEW — Barley)
	Wheat (See POWDERY MILDEW — Barley)	The varieties Arthur and Abe have some resistance. Blueboy is highly susceptible.
PURPLE STAIN *(Cercospora kikuchii)*	Soybeans Fungus which overwinters on diseased leaves and stems and in infected seed. Pinkish to dark-purple discoloration on the seed which varies from a small spot to entire area of the seed coat. Seeds often cracked in the discolored areas giving them a rough, dull appearance.	Early-maturing varieties tend to be more susceptible. More resistant varieties include Bethel, Dare, Delmar, Wye and Essex. Plant disease-free seed. Seed treatment with a fungicide aids in preventing loss of seedlings.
ROOT KNOT *(Meloidogyne* spp.*)*	Soybeans Nematode infestation. Knots or galls on the root system, especially near the soil surface. Plants may be severely stunted, wilt and die before harvest. May occur in circular to irregular patches throughout the field.	Plant resistant varieties which include Delmar and Forrest.

DISEASE	DESCRIPTION AND DAMAGE	CONTROL AND MANAGEMENT PRACTICES
ROOT ROT and CROWN ROT *(Fusarium* and *Helminthosporium* spp.*)*	Barley Caused by several fungi, including *Fusarium* and *Helminthosporium*, which live in the soil and on old stubble. Seedlings may be blighted. Plants stunted and pale. Roots brown and decayed. Crown (in heading and tillering stage) may be discolored with evident fungus growth. Seeds are shriveled.	Crop rotation to legumes. Clean plowing (to reduce stubble). Promote rapid emergence by planting in well-prepared and warm seed bed. Seed treatment may help.
	Wheat (See ROOT ROT and CROWN ROT—Barley)	
ROOT ROTS	Alfalfa and Clovers Can be caused by several kinds of fungi. Plant not healthy. Crown decayed, roots affected, tissues corky, brown to blackish, some shoots dead.	Use best varieties, good cultural practices. Crop rotation helps.
(Fusarium and *Rhizoctonia)*	Soybeans Caused by a number of soil fungi, the most important being *Fusarium* and *Rhizoctonia*. Infected seed my germinate poorly. May be preemergence and postemergence damping-off seedlings. Reddish-brown or brown lesions may occur on stems of mature plants, below and/or above the soil line. Severely infected roots rot. Plants may appear yellowish and stunted, wilt and die during moisture stress. Often occurs as "patches" in the field or as "skips" in the rows. Associated with low-lying, poorly-drained areas.	Cultivate only when adequate soil moisture is available. Ridging soil around base of plants aids in control of Fusarium rot by promoting development of roots above the diseased area. Crop rotation of little value. No resistant varieties available.

DISEASE	DESCRIPTION AND DAMAGE	CONTROL AND MANAGEMENT PRACTICES
ROOT ROT, STALK ROT and EAR ROT *(Diplodia* and *Fusarium* spp. *Gibberella zeae)*	Corn Caused by several fungi which overwinter on crop debris, in the soil or are carried on the seed. Brownish decayed areas on and in the roots which may progress into the stalk base. Plants are stunted and lack vigor. Roots and stalk die early and rotted stalks break over as the ears mature. Ear rot occurs as a pinkish, white, gray or black mold growth over the kernels.	Crop rotation. Clean plowing or removal of dead stalks and leaves. Use only disease-free, fungicide-treated seed. Maintain balanced soil fertility and control soil insects.
SCAB or FUSARIUM BLIGHT *(Fusarium* spp.*)*	Barley (See SCAB or FUSARIUM BLIGHT—Wheat)	
	Oats (See SCAB or FUSARIUM BLIGHT—Wheat)	Resistance in Clintland 64 and Jaycee.
	Rye (See SCAB or FUSARIUM BLIGHT—Wheat)	(See SCAB or FUSARIUM BLIGHT — Wheat)
	Wheat Fungi that overwinters on crop debris and/or within the seed. May occur as a seedling blight, Root rot or Head blight. They first appear watersoaked, turn yellowish and finally become a bleached straw color. Such heads do not fill out properly and contain light shriveled seed that is grayish or pink. Head blight may also be severe on barley or rye.	Crop rotation and clean plowing. Clean seed thoroughly to remove badly infected seed. Seed treatment recommended. The varieties Bluboy and Redcoat are susceptible.
SCALD *(Rhynchosporium secalis)*	Barley Fungus disease which overwinters on dead leaves and volunteer barley. Elongated spots, on leaves and leaf sheaths, with light centers and dark brownish edges. Leaves may be killed.	Crop rotation. Clean plowing to bury old stubble. The varieties Barsoy, Hanover, Jefferson, Knob, Pennrad and Rapidan have moderate resistance.

DISEASE	DESCRIPTION AND DAMAGE	CONTROL AND MANAGEMENT PRACTICES
SCLEROTINA CROWN ROT and STEM ROT *(Sclerotinia trifoliorum)*	Alfalfa and Clovers Caused by a fungus which is soil-borne and can survive indefinitely in the soil. Especially severe in young stands and early-growing varieties. Fungus attacks stems and crowns in wet, cool springs. The crown or base of the stem becomes soft and discolored. A white fluffy mass grows over the area forming hard, black bodies (sclerotia) which may be on the surface or embedded in the stem or crown.	Cut early when disease is severe. Do not plant a dense stand or over-fertilize with nitrogen. Plow deep to bury sclerotia. Keep land free of legumes for several years to reduce concentration of the fungus in the soil. Williamsburg variety has some resistance locally.
SEEDLING BLIGHT	Barley (See SPOT BLOTCH — Barley)	
	Corn (See SEED ROT — Corn)	
SEED ROT and SEEDLING BLIGHT	Corn Caused by several fungi which overwinter on crop debris, in the soil or are carried on seed. Seeds may decay or seedlings are blighted before emergence. Also, seedlings that emerge can be stunted and have brownish rotted roots. Usually worse in cold, wet soils. (See EAR ROT fungi)	Practice crop rotation and destroy old corn stalks. Plant when soil is warmer. Plant only seed treated with a fungicide.
SEPTORIA LEAF BLOTCH *(Septoria avenae)*	Oats Fungus disease which may be seed-borne and persists on crop debris. (See LEAF BLOTCH and GLUME BLOTCH — Wheat)	(See LEAF BLOTCH and GLUME BLOTCH — Wheat) Good cultural practices; use resistant varieties.
(Septoria secalis)	Rye Fungus disease. (See LEAF BLOTCH and GLUME BLOTCH — Wheat)	

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DISEASE	DESCRIPTION AND DAMAGE	CONTROL AND MANAGEMENT PRACTICES
SMUT *(stilago maydis)*	Corn A fungus which overwinters as a spore and may be wind-blown long distances. Not serious in Maryland. Small or large, silvery-white galls or "boils" that may occur on tassel, ears, husks, leaves or stalk. Most common on ears and on younger plants. Boils break open to release dark brown to black sooty masses of spores.	Most grain and silage varieties are resistant. Cut and ensile green corn before the boils mature and rupture. Or, where possible, remove and destroy galls before they break open. Burn or bury deeply. Practice rotation and sanitation (cleaning up crop debris, etc.). Control corn borer and corn earworm. Seed treatment not effective.
SOOTY MOLD	Barley (See SOOTY MOLD — Wheat)	
(Cladosporium herbarium)	Wheat Appears as a black moldy growth over entire plant during wet periods near harvest.	None known. Not harmful except in prolonged wet seasons.
SOUTHERN LEAF BLIGHT *(Helminthosporium maydis)*	Corn Fungus infection. Race "O" causes tan spots (¼ x ¾ inch) with parallel sides and brownish borders. Usually attacks only leaves. Race "T" causes tan spots (½ x ½ to 1½ inches) that are spindle-shaped and surrounded by a yellowish "halo". Later, spots often have a dark, reddish-brown border. May occur on leaves, stalks, leaf sheaths, husks, shanks, ears or cobs.	Use the more resistant varieties. Practice crop rotation and sanitation (destruction of crop debris, clean plowing, etc.). Keep fertility well balanced. Where appropriate, such as on seed corn, fungicides may be applied.
SPOT BLOTCH and SEEDLING BLIGHT *(Helminthosporium sativum)*	Barley This and other fungal species are carried on the seed and/or overwinter on infected stubble. Chocolate-colored leaf spots are round or elongated with a distinct margin. Spots may merge to form blotches covering large areas of the leaf. Leaves may dry up. Seedlings are frequently blighted and killed. Blackened areas occur on stems and lower leaves.	Crop rotation with legumes. Clean plowing. Plant the more resistant varieties which include Barsoy, Jefferson, Knob, Pennrad and Rapidan. Seed treatment is beneficial.

DISEASE	DESCRIPTION AND DAMAGE	CONTROL AND MANAGEMENT PRACTICES
SPRING BLACK STEM *(Phoma medicaginis)*	Alfalfa Fungus which persists in crop refuse in soil and may spread through infected seed. Dark brown or black lesions appear on stems and leaf petioles. Most of the lower stem may turn black. Young shoots are girdled and killed. Brown spots may also occur on leaves which turn yellow and drop. Favored by cool, moist weather.	Plant recommended varieties disease-free seed. Treat seed thiram. Rotate to grass or cereal crops. Good cultural practices help.
STALK ROT	Corn (See ROOT ROT — Corn)	
STEM BLIGHT	Soybeans (See POD BLIGHT — Soybeans)	
STEM ROT	Alfalfa and Clovers (See SCLEROTINA CROWN ROT — Alfalfa and Clovers)	
STEWART'S WILT	Corn (See BACTERIAL WILT — Corn)	
STORAGE ROTS *(Aspergillis, Fusarium, Penicillium)*	Corn Caused by several different fungi, the most important ones being Aspergillis, Fusarium and Penicillium. Pinkish, bluish-green, black or white mold growth on or between the kernels of the ear. In shelled grain, whole kernels may be discolored. This is accompanied by a musty odor, heating and caking of the grain.	Harvest ear corn at a moisture content below 20 to 23 percent and store in well-ventilated covered crib. If ears become moldy in the field, artificially dry to low moisture content to stop mold growth. Shelled grain should be dried to 13 to 15 percent moisture and aerated to maintain a uniform temperature of 4 to 10°C. throughout the bulk. Chemical storage additives may be used.

DISEASE	DESCRIPTION AND DAMAGE	CONTROL AND MANAGEMENT PRACTICES
VIRUSES (Maize dwarf mosaic, Maize stunt)	Corn There are several viruses that infect corn. Probably the most important are maize dwarf mosaic and maize stunt. Maize dwarf mosaic - a virus. Maize stunt - mycoplasma-like organism. Maize dwarf mosaic first appears as chlorotic spots or streaks between the veins on youngest leaves. As leaves mature, they have a fine mottle or mosaic of light and dark green. Plants may be shorter and more spindly than normal. Maize stunt appears as faint yellowish streaking in lowest leaves. Intensity of yellowing increases as plant matures and upper leaves usually turn red by time ears are formed. Plant may be stunted with a "bunchy" appearance at the top.	*Maize dwarf mosaic — Use resistant varieties* and destroy Johnsongrass which serves as an alternate host for the virus.
Mosaic	Alfalfa and Clovers Small, greenish-yellow spots followed by extensive and diffuse chlorosis. Leaflets become crinkled, irregular, brittle with no necrosis. Vector is pea aphid.	Use resistant varieties. Control aphids.

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DISEASE	DESCRIPTION AND DAMAGE	CONTROL AND MANAGEMENT PRACTICES
YELLOW DWARF	Barley Virus which is carried in many cultivated and wild grasses, which may or may not show symptoms of the disease. Is transmitted by several species of aphids. Also on Wheat and Oats. Not common in Maryland. Leaves turn yellow from the tip downward, with the midrib last to become yellow. Plants infected prior to the 4 or 5 leaf stage are severely stunted and may not head. Root systems are also severely stunted. Damage not as severe when plants are infected at latter growth stages. Wheat varieties may have yellow and red cast. Oat leaves turn red with severe blasting of head.	Plant so that the very susceptible seedling stage occurs before or after the peak of the aphid populations. Aphid populations increase during the warm summer months. Use the more resistant varieties where available.
	Oats (See YELLOW DWARF — Barley) Similar to barley except leaves turn red rather than yellow. Severe blasting of the florets may occur.	(See YELLOW DWARF — Barley) Resistance in Jaycee. Control aphid.
	Rye Similar to barley infection. Leaves show principally a chlorosis although some yellowing may occur. (See YELLOW DWARF—Barley)	(See YELLOW DWARF — Barley)
	Wheat (See YELLOW DWARF — Barley) Similar to barley. Plants are a lighter green in color than normal. Some varieties will look yellow or red, depending on weather conditions.	(See YELLOW DWARF — Barley)
YELLOW LEAF BLIGHT *(Phyllosticta maydis)*	Corn Fungus infection. Rectangular to oval, light or tan-colored spots (1/10 x ½ inch) appear first on outer half of lower leaves. Small black specks develop in the spots. Leaves first appear yellow as if nitrogen deficient, then turn brown and die. Plants may be stunted.	Use the more resistant varieties. Practice crop rotation and sanitation (destruction of crop debris, clean plowing, etc.). Keep fertility well balanced. Where appropriate, such as on seed corn, fungicides may be applied.

PLANT - INSECT INDEX

ALFALFA
- Alfalfa weevil
- Meadow spittlebug
- Pea aphid
- Potato leafhopper

CORN
- Armyworm
- Corn flea beetle
- Cutworm
- European corn borer
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SMALL GRAINS
- Armyworm
- English grain aphid
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SOYBEAN
- Corn earworm
- Green cloverworm
- Mexican bean beetle
- Spider mites

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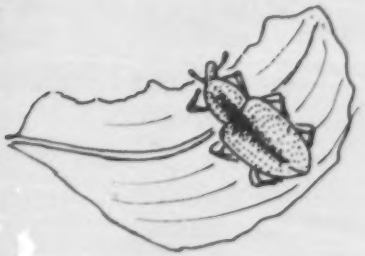
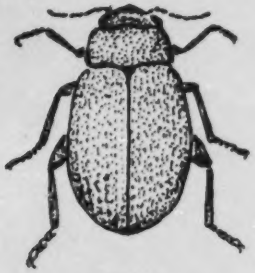
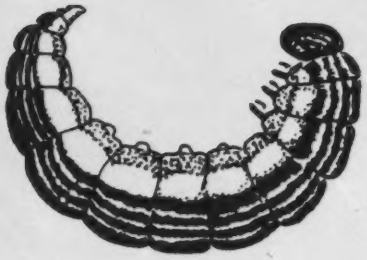
NAME	DESCRIPTION AND DAMAGE	LIFE CYCLE	CONTROL OR MANAGEMENT PRACTICES
ALFALFA WEEVIL *(Hypera postica)*  Adult	Alfalfa Adult causes very little injury on first cutting, but may seriously damage stubble growth on second cutting. Grayish-brown weevils about ¼ inch long with a dark triangular area (brown or black) at the base of wings. Larvae are light green with black heads and a light white stripe down the back. Damage is usually associated with first cutting of alfalfa. Larvae skeletonize the leaves, giving them a grayish or frosted appearance.	Adults overwinter and lay eggs in the alfalfa stems in the spring. Larvae hatch from mid-April to early May and complete development in June, before the second cutting. Only one generation is produced each year.	Control options. Cut early and do not spray. Allow established parasites to control weevil. Insecticide spray can be applied when 50 percent of tips show injury. See Extension Bulletin 237.
ARMYWORM *(Pseudaletia sp.)* Larva	Corn Full-grown larvae are about 2 inches in length, slightly pink or cream colored with alternating light and dark stripes on the back. The larvae "rag" or, in the case of heavy populations, completely strip the foliage from the young plant.	There are usually 2 or 3 generations per season, but the first generation during the spring (May-June) is the most important. Larvae usually feed at night and during the day, rest within the whorl or under weeds or mulch materials in the field. Armyworms frequently "march" out of small grain into adjacent corn fields.	Natural enemies regulate the second or third generations and usually only the first requires controls. Consult Extension Bulletin 237 for details.

NAME	DESCRIPTION AND DAMAGE	LIFE CYCLE	CONTROL OR MANAGEMENT PRACTICES
ARMYWORM (Cont.)	Small grains (See Armyworm — Corn.) Armyworms will strip the foliage and then clip the heads off barley. On wheat, the larvae also strip foliage but usually nip several individual grains and only rarely clip the entire head. Severe damage to barley fields can occur in just 2 to 3 days when larvae are full grown. Larvae prefer weedy or lodged areas in the field.	Adult moths fly at night and lay eggs in the fields during April and May. Only the first generation causes damage to small grains. The most severe damage occurs from mid-May to June when most of the larvae are maturing. When small grains dry out, the larvae "march" out of the field and frequently attack adjacent corn crops. Young larvae usually feed at night. When disturbed during the day, larvae curl up into a "C" shape position.	Spray small grains when larvae average 1 per linear foot of crop row. See Extension Bulletin 237 for details.
CORN EARWORM *(Heliotus zea)* Larva	Soybeans Larvae are usually pod feeders. Earworms, when full-grown, are about 1½ inches long, and vary in color from pink, olive green, yellow, brown to almost black. The underside is usually light colored. Larvae usually possess longitudinal stripes on the sides and back.	Usually have 2 generations per season. The larvae will eat a round hole through the side of the pod and consume part or all of the seed inside. Occasionally larvae will feed on the young tender foliage. Injury to soybeans usually occurs late in the season after most of the corn in the area has started to dry up and mature.	During wet periods in August and September many larvae are killed by a fungus disease. Controls should be applied when larvae average 1 or more per linear foot of crop row. See Extension Bulletin 237 for details.

NAME	DESCRIPTION AND DAMAGE	LIFE CYCLE	CONTROL OR MANAGEMENT PRACTICES
CORN FLEA BEETLE *(Chaetocnema pulicaria)*  Adult	Corn Flea beetle is a small, shiny, black species about 1/16 inch in length. When disturbed, the beetle will jump from the plant. The feeding injury on young plants appears as small holes through the foliage. On older plants, the beetle may produce long gray streaks or feeding scars on the leaves. These beetles may also inoculate plants with a bacterial disease known as "Stewart's Disease".	There are 1 or 2 generations per season. The adults usually overwinter near the field and attack young corn plants as soon as they emerge from the soil.	Treat young plants when beetles average 6 or more per plant, and plants are 3 inches or less. Older corn can usually tolerate large numbers of beetles without having yields reduced.
CUTWORMS *(Noctuidae)*  Larva	Corn Cutworms are smooth, fat, soft and dark colored caterpillars about 1½ inches in length when full grown. The color patterns will vary depending on the species. Some species sever the entire plant when the corn is small. Later they may feed like armyworms or burrow into the base of the plant. All species feed at night or on cloudy days.	There are 2 or more generations per season, but only the overwintered larvae or first generation larvae are of concern in Maryland. Cutworms feed primarily at night. In order to check for cutworms during the day, dig around in the soil next to the severed plant. They often play dead when first discovered.	Treat at first signs of damage, and direct the sprays to the base of the plant. Consult Extension Bulletin 237 for control details.

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NAME	DESCRIPTION AND DAMAGE	LIFE CYCLE	CONTROL OR MANAGEMENT PRACTICES
ENGLISH GRAIN APHID *(Macrosiphum avenae)* Wingless and winged aphids	Small grains Small, dark green aphids, usually clustered on the foliage or heads. Excessive feeding causes the foliage to appear yellow and eventually die. Aphids feeding in the grain head will cause a reduction in yields.	This aphid is found on all small grains in the fall and spring. Populations are usually held in check by several natural enemies during the spring. Aphids will usually move from the foliage and infest the developing grain heads.	Before head development: Treat foliage when aphids average 200 to 250 per linear foot of crop row. When aphids attack the heads: Treat when aphid counts average 25 per head. See Extension Bulletin 237 for insecticide recommendations.
EUROPEAN CORN BORER *(Ostrinia nubilalis)* Larva	Corn Eggs are tiny, flat and white, often resembling 15 to 20 small fish scales. The female attaches the egg mass to the undersurface of the leaf. Corn must be at least 12 inches high before the female will deposit eggs on the plant. Newly hatched larvae feed on the leaves before crawling into the whorl or stem of the corn plant. The mature larvae are about 1 inch long, pink or cream colored, with a dark brown or black head. Several rows of spots and pale brown or pink lines extend the length of the caterpillar. Younger larvae may often cause breakage of the leaf midribs. Older larvae tunnel into the stalk and ear shanks, thus weakening the plant or ear. The ears often drop before or during harvest.	There are 2 to 3 generation per season. Mature larvae overwinter in the stalks and pupate early in spring. The first generation usually attacks the corn in the late whorl stages. The second generation attacks corn in the silking or tassel stages.	Treat when 75 percent of plants show first generation feeding in the late whorl stage. No controls for second generation. Plow under or rotary mow old stalks in the fall or early spring before moths emerge in May. Plant early and use resistant hybrids.

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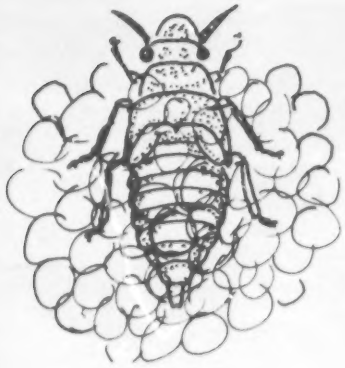
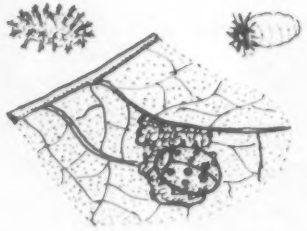
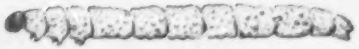
NAME	DESCRIPTION AND DAMAGE	LIFE CYCLE	CONTROL OR MANAGEMENT PRACTICES
GREEN CLOVERWORM *(Plathypena scabra)* Cloverworm larva and damage	Soybeans The larvae are light green with two white stripes along each side of the body. These worms twist and turn violently when placed in the palm of the hand.	There are 2 generations per year. Green cloverworms cause ragging and defoliation of plants.	Natural controls such as fungal diseases, parasites and predators often prevent outbreaks in Maryland. Treat when foliage injury averages 33 percent or more, and there are more than 8 small- or medium-sized caterpillars per foot of crop row.
HESSIAN FLY *(Mayetiola destructor)* Adult and larva	Small grains Fly is very tiny, black and only lives about 4 days. The larva is white, pointed at both ends and is about ½ inch long. The larvae feed near the crowns and under the leaf sheaths near the joints of the plant. Plants that are injured in the fall appear dark bluish-green in color. Maturing heads will have fewer seeds than normal plants.	Hessian fly attacks wild grasses, barley and wheat, but never oats. Adults and maggots can be found throughout the summer, but egg laying will continue until fall.	No insecticide treatments recommended. Plant wheat only after the Hessian fly safe-planting dates. The dates for each county are available from county Extension office.

NAME	DESCRIPTION AND DAMAGE	LIFE CYCLE	CONTROL OR MANAGEMENT PRACTICES
MEADOW SPITTLEBUG *(Philaenus spumarius)*  Nymph	Alfalfa Eggs overwinter inside plant stems. The eggs hatch and yellow-green nymphs begin to suck the plant juices in early spring when alfalfa is only ¾ inch high. Adults appear in late May and early June and live until fall. Feeding causes a stunting of the plant.	Only a single generation per year is produced. Eggs are laid in plant stem during the fall, and nymphs hatch the following spring. Nymphs are covered with a spittle mass which apparently provides protection from natural enemies.	Apply insecticide only when spittle mass counts average 20 per square yard before mid-May.
MEXICAN BEAN BEETLE *(Epilachna varivestis)*  Adult and damage Larva Pupa	Soybeans The adult is a leaf feeding beetle, oval and convex in form and about ⅓ inch long. Coppery yellow with 8 black spots on each wing cover. Adults may completely defoliate a seedling stand of soybeans in June. Larvae are yellow and covered with numerous branched spines. Larvae skeletonize the foliage. Pupae are nonfeeding. They are also yellow, with a whitish cast skin attached to the end which is connected to the undersurface of the leaf.	Usually 2 and possibly 3 generations per season. Adults overwinter in woodlands adjacent to soybean fields. They emerge in the spring and lay eggs in soybeans. The second generation is usually most serious in late July, August and September.	A wasp parasite released by the University of Maryland has proven to be effective in reducing larval populations. Mexican bean beetles begin to reach peak numbers on the Eastern shore starting in mid-August and last through September. Therefore, late soybeans in bloom or podding are, in general, most susceptible to economic injury (yield losses). Do not spray unless Mexican bean beetles are actively feeding on crop, and foliage damage averages 33 percent up to the time of bloom. After bloom, foliage damage should average 10 percent more than was present at bloom before spray is necessary.

NAME	DESCRIPTION AND DAMAGE	LIFE CYCLE	CONTROL OR MANAGEMENT PRACTICES
NORTHERN CORN ROOTWORM *(Diabrotica longicornis)*  Larva	Corn Adult is a pale green beetle without spots or stripes. The adult feeds on the fresh silks and thus may prevent pollination. Larvae are thread-like, white worms with segmented bodies, brown heads and are about ½ inch long when full grown. The larvae feed outside and inside the roots and thus prune the fibrous and brace root systems. Heavily damaged plants will easily lodge or take on a "gooseneck" appearance late in the season.	Only one generation per season. Egg overwinters in the soil and hatches during the spring. Larvae feed during spring and summer, then pupate in late summer (late July, early August). Adults are active during August. Heavy populations can be expected in fields where corn follows corn without rotation of another crop at least one year in three.	Avoid continuous production of corn in field having a history of rootworm infestations. Use insecticide treatment only in fields having a history of rootworm infestations. Adult control: Spray fresh silks only if adult counts exceed 5 per silk. See Extension Bulletin 237 for details.
PEA APHID *(Acyrthosiphon pisum)* Wingless and winged aphids	Alfalfa Large green aphid with black feet (some winged but most often without wings). These insects suck the sap and wilt the plant.	Aphids are most serious during spring and fall when the weather is cool and the parasites are not active.	Natural enemies usually regulate aphid populations, but insecticides listed in Extension Bulletin 237 may be used when aphids exceed 10 per sweep.

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NAME	DESCRIPTION AND DAMAGE	LIFE CYCLE	CONTROL OR MANAGEMENT PRACTICES
POTATO LEAFHOPPER *(Empoasca fabae)* Adult	Alfalfa Adults are winged, pale yellow-green, wedge-shaped, sap-sucking insects about 1/8 inch long. They are very flighty. Nymphs are more pale, sometimes yellow. Both stages suck the sap and turn the alfalfa foliage yellow.	Leafhopper does not overwinter in Maryland but migraes from the south each season. First adults arrive in June, and several generations are produced before cold weather kills them. The period from egg to adult is usually 3 weeks. The second, third and fourth cuttings of alfalfa are attacked in Maryland.	Apply insecticides when leafhoppers average 1 per sweep and regrowth averages 6 inches in height. If populations are heavy, a stubble spray may be required.
SPIDER MITES *(Tetranychidae)* Adult	Soybeans Extremely small, 8-legged mites with a pair of large, dark spots on the back of the abdomen. Most mites will vary in color from yellow to light green. Mites suck sap from the plants. Plants turn light yellow, then brown, before leaves begin to drop. Border rows are usually the first to turn yellow, then the yellowing proceeds in toward the middle of the field.	Mites may have as many as 10 to 12 generations per year. Mites overwinter and begin to develop in weeds and grasses at the edge of soybean fields. They then spread into the field during the summer. Heavy infestations are likely to occur when the weather remains very hot and dry over a 2- to 3-week period.	Treat during July and August when border crop rows start to yellow.

FIELD AND FORAGE CROP WEED PESTS

WEED	DESCRIPTION AND DAMAGE	LIFE CYCLE	CONTROL OR MANAGEMENT PRACTICES
ANNUAL BLUEGRASS *(Poa annua)*	*Poa annua*, more commonly known as annual bluegrass, is an annual weed imported from Europe and is found throughout the United States. *Poa annua* is a shallow rooted weed which looks like low growing Kentucky bluegrass but is a yellow-green color and lacks rhizomes. Plant matures and dies quickly under conditions of high temperatures and humidity. *Poa annua* is more noticeable during the cool and moist periods of early spring and fall, just before desirable grasses begin to grow or just after they become dormant.	Seeds germinate in the fall and spring; plants overwinter to form seed heads in April and May. Since it has no runners or underground root stock, it is spread only be seed. Plant flowers and seeds profusely. It is characterized by a whitish seed head appearing in April and May.	Cultural practices include restricted water use during peak periods of *Poa annua* germination, establishment of adequate drainage and proper timing for cultivation practices.
BARNYARDGRASS *(Echinochloa crus-galli)*	An annual with fibrous, rather shallow roots. Stems are 1 to 4 feet tall, thick, coarse, mostly erect, with smooth branching at the base. Leaves, both sheaths and blades, are smooth. Blades are 3/8 to 5/8 inch wide, and light green. The seed head is a panicle bearing several rather compact side branches, green or purplish in color. Florets are covered with conspicuous short, stiff bristles. The bearded seeds are tan to brown, oval with longitudinal ridges on the convex surfaces.	Seeds germinate in spring, and flower by mid summer. Seeds remain dormant for many years. The plants are killed by frost.	Crop rotation and cultivation can minimize this and other summer annual weeds. See Extension Bulletin 237, "Pest Control Recommendations — Field Crops".

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WEED	DESCRIPTION AND DAMAGE	LIFE CYCLE	CONTROL OR MANAGEMENT PRACTICES
BERMUDAGRASS *(Cynodon dactylon)*	A noxious weed. Perennial, reproducing by seed, stolons(above ground stems) and rhizomes (below ground stems). Rhizomes and stolons can form a dense sod. Leaf blades are slightly hairy or smooth except for hairs at the edge just above the collar; ligule is a ring of white hairs. Flower borne in finger - branched seed head of usually 5 branches (maybe as few as 3 or as many as 7). Seeds similar to timothy.	Seeds germinate in early summer to produce an aggressive seedling. Stolons root at each node to form a new plant. Rhizomes also form new plants at each node. Seed heads are formed in late summer. Most hybrid varieties will form few viable seeds; common bermudagrass forms viable seed. Plants go dormant at first frost and remain so until late spring. Rhizomes and stolons may be carried with tillage equipment. Found in sunny areas, lawns, pastures, crop land, roadsides and nursery planting.	Difficult to control by any one method. Clean seed, crop rotation.
BUCKHORN PLANTAIN *(Plantago lanceolata)*	Perennial reproducing by seed. Stems are short with leaves forming a basal rosette. Leaves emerge from the crown. Leaves 2 to 10 inches long, ¼ to 1 inch wide, hairy, with prominent veins running the length of leaf. Flowers are on a stem 4 to 12 inches long. Seeds, borne in 2 seeded pods, are small, brown, shiny, boat-shaped with an indentation in middle of one side, and the surface becomes sticky when wet. The plant competes with the crop for space, nutrients, light and moisture.	Seeds germinate during summer and early fall; seedling plant matures the following year to produce seed heads in late summer. Seeds ripen in fall. Plants are found in lawns, pastures, hay fields, red clover seed fields and waste places.	Use clean seed. Prevent seed head formation. Crop rotation, hand removal, and use of specific chemicals.

WEED	DESCRIPTION AND DAMAGE	LIFE CYCLE	CONTROL OR MANAGEMENT PRACTICES
CANADA THISTLE *(Cirsium arvense)*	A noxious weed. Perennial, reproducing by seed and an underground rootstock. Roots extend some distance and send up new plants. Stems are 2 to 5 feet tall, grooved, branching only at the top, slightly hairy as they mature. Stems may be spiny. Leaves have crinkled edges and spiny margins. Flower heads are numerous, lavender color, surrounded by bracts without spiny tips. Male and female flowers on separate plants. Seeds are brown, smooth-coated, slightly tapered, with a ridge around the blossom end which is seen when the "down" is removed.	Seed germinates, producing a seedling which in turn develops rootstock. New plants come from buds on the rootstock. Seedheads form in late June or later. Seed, when matured, is carried by the wind with the "down". Found in cultivated and waste areas. Rootstocks may be carried on tillage equipment.	Use clean seed, prevent seed formation, and use crop rotation. See Extension Bulletin 232 "Pest Control Recommendations — Field Crops".
CHICKWEED *(Stellaria media)*	Winter annual reproducing by seed and rooting at the nodes of the creeping stems. Root system is fibrous and shallow. Stems are branched, creeping or ascending to heights of 12 inches. Leaves are small, opposite, single, broadly ovate, pointed at the tip, smooth. Petioles have a line of hairs on one side. Flowers are small, white with fine, deeply matched petals. Seed pod is cylindrical, breaking into 5 segments at maturity, containing many seeds. Seeds are small, dull reddish-brown, somewhat heart-shaped but nearly round, roughened by curved rows of minute tubercules. Lush growth in alfalfa prevents proper field curing.	Seed germinates in fall and early winter, growing rapidly until extreme cold sets in. Flowering will begin in the fall and proceed during warm spells in the winter but develop profusely in the spring. Growth and seeding usually stops during extreme hot weather, and seed will shatter to the ground. Seeds may be found in some poor quality pasture land. Plants are found in most cultivated areas.	Clean seed, crop rotation, winter crops, hand removal of plants before seeding and clipping are useful. Use chemicals recommended in Extension Bulletin 237, "Pest Control Recommendations — Field Crops".

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WEED	DESCRIPTION AND DAMAGE	LIFE CYCLE	CONTROL OR MANAGEMENT PRACTICES
COCKLEBUR *(Xanthium pensylvanicum)*	An annual reproducing by seed, taproot is large with woody stems, erect, bushy, 2 to 4 feet tall. Leaves are rough, hairy, spotted, alternate, triangular shaped tooth, or lobed, rough with long petioles. Flowers are small; male and female, flowers separate, but are borne together in a cluster in axils of upper leaves. Two female flowers are enclosed in each oval burr. When mature, each burr becomes hardy, woody and covered with hooked spines with curved spines at top end. Male flowers are numerous on short stalks and are dropped soon after pollen is shed. Seeds are ½ inch long, dark brown, rather slender with pointed tips.	Seeds germinate in early summer, growing rapidly to flower in late August and September. Seeds fall to ground, stick to dogs and other animals to be carried to new locations. Seed may be carried with soybean seed or by burlap bags. Found in cultivated fields especially soybean, set aside acres, poor pastures, along edge of woods and roadsides.	Clean seed, crop rotation, cultivation, hand removal of plants before seeding and clipping, will reduce the problem. Specific chemical as cleared and recommended in Extension Bulletin 237, "Pest Control Recommendations — Field Crops".
COMMON LAMBSQUARTERS *(Chenopodium album)*	An annual reproducing by seed. Stems are 3 to 4 feet tall. Sometimes have a much branched root system. Red or light green striations often mark the smooth stems, usually with very little branching. Leaves are alternate, simple, ovate in shape, with edges irregularly toothed, mealy beneath. Flowers are small and green without petals, found at the ends of the branches and in the axils of the leaves. Seeds are lens-shaped, with a marginal notch, black and somewhat glossy, about 1/16 inch in diameter, often with fruit parts attached.	Seeds germinate mainly from spring to early summer producing flowers in late summer or early fall. Seeds fall to ground or are carried in crop seed through harvest. Plants produce numerous seeds. Found in cultivated crops and gardens.	Can be easily controlled early in the plant's growth by hoeing, pulling, mowing, or cultivation and crop rotation. See Extension Bulletin 237, "Pest Control Recommendations — Field Crops".

WEED	DESCRIPTION AND DAMAGE	LIFE CYCLE	CONTROL OR MANAGEMENT PRACTICES
COMMON MORNINGGLORY *(Ipomoea spp.)*	An annual, reproducing by seed. Stems are hairy, twining or spreading on the ground and climbing around and up the plant. Leaves are alternate, hairy. Flowers are funnel-shaped, white, purple or pale blue, borne singly on long stalk. Seed pods are egg-shaped, partly covered by bristly calyx, usually with four to six seeds. Seeds are about ¼ inch long, dark brown to black, with one round and two flattened sides.	Seeds germinate in spring and early summer and continue to grow throughout the summer, blooming and producing seed to ripen by late summer or fall. Found in gardens, fields and waste places. A troublesome weed of cultivated fields, especially corn, soybeans and tobacco, where it ties plants together prior to harvest.	Crop rotation and clean seed. See Extension Bulletin 237, "Pest Control Recommendations — Field Crops".
COMMON RAGWEED *(Ambrosia artemisiifolia)*	Summer annual, erect, usually 2 to 3 feet or more tall, bushy-branched. Root system is fibrous. Leaves are nearly smooth, deeply cut into several, toothed portions, mostly alternate, and deep green in color on the upper surface but paler beneath. The flower heads are of two kinds; pollen-producing heads, small, borne in slender clusters at the tips of the branches; seed-producing heads, few and inconspicuous when young, borne with small leaves at the bases of leaves and in the forks of upper branches. Seeds are about ⅛ inch long and are enclosed in a pointed, somewhat top-shaped, woody hull; light brown in color and bearing several longitudinal ridges ending in short spiny projections.	Seeds germinate in spring to early summer. Flowers from July through September and seeds mature from August until frost. Found in cultivated fields, run-down pastures, abandoned areas and roadsides.	Good cultivation and mowing can control this weed by preventing flowering, pollen production and seed formation. See Extension Bulletin 237, "Pest Control Recommendations — Field Crops".

WEED	DESCRIPTION AND DAMAGE	LIFE CYCLE	CONTROL OR MANAGEMENT PRACTICES
CORN CHAMOMILE, Mayweed, Dogfennel, or Daisy *(Anthemis spp.)*	Winter annual with a short thick taproot reproducing only by seed. Stems are erect, slender, much branched, nearly smooth, from 12 to 18 inches tall. Leaves are finely divided and have a strong disagreeable odor. The flower heads resemble those of a daisy, ½ to 1 inch across, borne singly at the ends of branches. Ray flowers are white, surrounded by a mass of numerous, small, yellow, disk flowers. Seeds are brown, oblong, 10-ribbed, with a rough seed coat. Damage this plant does is crowding the small grain and causing fresh plant material to be put through the combine, thereby interfering with the combining process.	The seed germinates in the fall with the small grain and overwinters. In the spring, the plant will begin rapid growth from the overwintering rosette and flower by mid-April to May. After flowering the plant usually dies.	Although crop rotation will reduce the number of seeds, this practice will not eliminate the weed. A good cover and stand of small grain will minimize the weed. See Extension Bulletin 237, "Pest Control Recommendations — Field Crops".
CORN-COCKLE *(Agrostemma githago)*	Winter annual reproducing by seed; shallow taproot. Stems are rough, hairy and erect and may obtain a height of 4 feet, branching. Leaves are opposite, joining at their base, hairy and slender. Flowers are purple with narrow green sepals. Seeds are contained in a 10-ribbed urn-like seed pod. Seeds are black on the outside and white inside, triangular, rough surface; seeds are poisonous. Corn-cockle is particularly troublesome in small grain. Objectionable in grain for milling.	Seeds germinate in fall, forming a rosette during winter. Stems elongate in spring; flowers in late May. Seeds mature in June. Found in wheat, barley, oat, rye, hay fields and waste areas.	Use clean seed of small grain, practice crop rotation and maintain clean fence rows. Use specific recommended chemicals. See Extension Bulletin 237, "Pest Control Recommendations — Field Crops".

WEED	DESCRIPTION AND DAMAGE	LIFE CYCLE	CONTROL OR MANAGEMENT PRACTICES
CRABGRASS *(Digitaria spp.)*	An annual, tufted plant, stems mostly prostrate, freely branching. The top of the flowering branches are 4 to 7 fingered, radiating outward from the main stem. The small individual flowers are in 2 rows on one side of the flattened stalk. Seeds are long, oval, finely-granular and light yellow. There are 2 common species; large crabgrass, *Digitaria sanguinalis* and small crabgrass, *Digitaria ischaemum*.	Seeds germinate from spring to early summer. Flowering occurs in mid-summer as the plant matures; rooting can occur at the nodes of prostrate stems. Found in gardens, fields, lawns and waste areas.	A good shading or completing crop will suppress it. Practice cultivation, hoeing and crop rotation. See Extension Bulletin 237. "Pest Control Recommendations — Field Crops".
DANDELION *(Taraxacum officinale)*	A perennial reproducing by seed. Root is thick, fleshy, with branches. New sprouts can come up from roots or root segment. Stem never elongates but produces a rosette of leaves. Leaves are simple, variously lobed, 3 to 10 inches long, containing a milky juice. Flower heads are smooth, hollow and are borne on a long stalk from the crown, bearing flowers 1 to 2 inches in diameter. Seeds are about 3/16 inch long, with a brownish color having a long tip with a tuft of hair. Seeds are rarely found as a contaminate in good seed. Plants are found in lawns, fields, meadows and waste places.	Seeds germinate in late summer or early fall. In the first spring a single flower may develop but thereafter many flowers per plant develop. The wind carries the seed to new areas.	Use crop rotation, hand removal and chemicals.

WEED	DESCRIPTION AND DAMAGE	LIFE CYCLE	CONTROL OR MANAGEMENT PRACTICES
DOCKS *(Rumex spp.)*	There are two species: Curled dock and broadleaved dock. Both are perennials with a large yellow, somewhat branched taproot, reproducing by seed. Broadleaved dock is similar to curled dock. Leaves of broadleaved dock are broad and flat with a heart-shaped base; leaves of curled dock are mostly wavy-curled edged, lanceloate, smooth, 6 to 12 inches long. Stems of both plants are smooth, erect, 1 to 4 feet tall, single or in groups from the root crown. Flowers of both species are in dense clusters on branches at tip of stems. Flowers are without petals and are small, greenish, becoming reddish-brown at maturity. Seeds of both are brown, shiny, triangular and sharp-edged, surrounded with a bract with smoothed edges in curled dock and toothed edges in broadleaved dock.	Seeds germinate in the spring; plant is a dense rosette of leaves; plant flowers the second year.	Clean cultivation will control this weed. Cutting the plant off several inches below the ground surface is effective in killing plants. See Extension Bulletin 237, "Pest Control Recommendations—Field Crops" for postemergence chemical control.
DODDER *(Cuscuta spp.)*	Annual, parasitic plant reproducing by seed. Seeds germinate but develop no root system. Stems are stringlike, smooth, yellow or orangish, branching structures. The stems have no leaves except for small bracts. Flowers are numerous, small, white, with 5 lobes and are borne in clusters. Seeds are small brown and triangular with rough surfaces. Pods have paper-thin walls containing 4 seeds. The stems of dodder attach directly to the host plant, taking most of the dodder sustenance from the host crop. Damage is in the form of reduced growth of the crop and an undesirable parasitic plant growth on the crop.	Seeds germinate in late spring and summer. The stringlike stem twines around plants, usually legumes and occasionally grasses; send rootlike projections (haustoria) into the stem of the host plant. Dodder flowers durthe summer and early fall producing an abundance of seeds. Found in clover, alfalfa and lespedeza fields, gardens and waste areas.	Use clean seed, practice crop rotation, and destroy the host plant.

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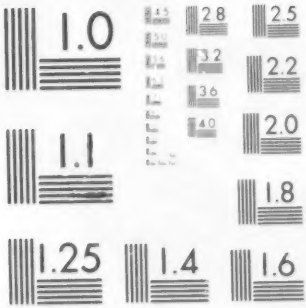
WEED	DESCRIPTION AND DAMAGE	LIFE CYCLE	CONTROL OR MANAGEMENT PRACTICES
FALL PANICUM *(Panicum dichotomiflorum)*	An annual with fibrous roots reproducing by seed. Stem are 20 to 50 inches long, smooth, spreading, often flat on the ground, rooting at the lower nodes. Leaves are smooth or sparsely hairy. Leaf sheaths are heavy, short, smooth loose and a reddish-purple color Panicles open with many branches. Seeds are yellow, smooth, enclosed in hulls which often separate when ripe.	Seeds germinate from spring to midsummer. More serious on edge of corn and soybean fields and where there is little competition from other plants. Shading suppresses fall panicum germination and growth. Plant develops rapidly, producing many seeds.	Practice crop rotation, cultivation and obtain good crop stands. See Extension Bulletin 237 "Pest Control Recommendations — Field Crops".
FIELD BINDWEED *(Convolvulus arvensis)*	Perennial reproducing by seed and rootstock. Root system extensive; may extend as much as 20 feet. Stems are smooth, slender, 2 to 7 feet long, twining or spreading over surface of the ground. Leaves are ovate with spreading basal lobes. Flowers are white or pink funnel-shaped about 1 inch across. Flower stalk has two bracts, ½ to 2 inches below the flower which distinguishes this weed from hedge bindweed. Seed pods are egg-shaped, usually containing 4 seeds. Seeds are dark, brownish-gray, roughened surface, with one rounded and 2 flattened sides.	Overwinters and reproduces from seed or rootstock, beginning growth in late spring or early summer. Produces a large root system. Flowers and produces seed in late summer or early fall. Found in cultivated fields as well as noncultivated areas and in most cropping systems. May climb on crops, dragging plants to the ground and choking them out.	Crop rotation. See Extension Bulletin 237, "Pest Control Recommendations — Field Crops".

WEED	DESCRIPTION AND DAMAGE	LIFE CYCLE	CONTROL OR MANAGEMENT PRACTICES
FIELD PEPPERGRASS, Methodist weed *(Lepidium campestre)*	Winter annual reproducing by seed. Stems are branched, 6 to 8 inches tall. Leaves are long, coarsely toothed, with basal leave obovate with one large terminal lobe. Flowers are small and white, borne in racemes which grow for a month or so. There may be ripe seed at the bottom and blossom at the top. Seeds are found in round pods about ⅛ inch in diameter. It is particularly troublesome in forage crops where it reduces the feeding quality and yield.	Seeds germinate in late fall and form a winter rosette. In early spring, the plant will bloom, forming seed in April to June. Found in fields, gardens, roadsides and waste areas.	Crop rotation and cultivation can prevent seed development.
FOXTAIL Giant *(Setaria faberi)* Green *(Setaria viridis)* Giant green *(Setaria viridis* var. *major)* Yellow *(Setaria lutescens)*	An annual reproducing by seed. *Giant:* Stems are 3 to 7 feet tall. Leaves covered with short hairs on upper surface. Panicle extremely dense, 3 to 8 inches long, bending near the bases with heads drooping; 3 to 6 bristles extend from each spikelet. Seeds are greenish, smaller than yellow foxtail and larger than green. Seed head yellowish-brown in color. *Giant green:* Stems are 3 to 7 feet tall. Resembles giant foxtail except leaves are hairless. Panicle extremely dense, 3 to 8 inches long, bending near the base with head drooping. Seed head purplish-brown in color. *Green:* Stems are smaller than giant, only 1 to 3 feet tall and erect. Leaves are hairless. Panicle extremely dense, 1 to 3 inches long and usually erect. Seeds and seed head green and smaller than giant. *Yellow:* Stem erect, 1 to 2 feet tall. Leaves flat, often having a spiral twist, with long hairs on the upper surface near the leaf base. Panicle extremely dense, erect. Spikelet with 5 or more bristles. Seed larger, yellow with some dark brown.	Seeds germinate in spring. Young seedlings develop rapidly. Plants will tiller, forming 4 to 8 seed heads which mature in fall. Found in cultivated crops, garden alfalfa and hay fields, lawns, roadsides and waste areas.	Use clean seed and practice crop rotation and cultivation. Mowing prevents seed formation. These four types of foxtails are susceptible to herbicides to a similar extent. See Extension Bulletin 237 "Pest Control Recommendations — Field Crops".

WEED	DESCRIPTION AND DAMAGE	LIFE CYCLE	CONTROL OR MANAGEMENT PRACTICES
HEMP DOGBANE *(Apocynum cannabinum)*	Perennial reproducing by seed and long horizontal rootstock. Stems are erect, 2 to 4 feet tall from a woody base. When stem is ruptured it exudes milky juice. Leaves are erect, elliptical, narrow and smooth edged. Flowers have 5 greenish-white petals which are slightly longer than the green sepals. Seed pods are smooth, long and slender. Seeds are thin and flat with a tuft of soft, silky, white hairs at one end.	Seeds germinate in spring to form young seedlings that produce spreading rootstocks. New plants come up from rootstocks in late spring and bloom during summer producing seeds in pods which open in the fall. Wind carries seed to new areas. Particular problem in no-tillage fields, fields not cultivated and wastelands.	Mow to prevent seed formation. Use crop rotation to break up patches and expose rootstocks. See Extension Bulletin 237 "Pest Control Recommendations — Field Crops".
HENBIT *(Lamium amplexicaule)*	Winter annual reproducing by seed. Roots are fibrous; stems are 4 to 16 inches tall, slender, smooth, 4-angled, with many branches that are more or less prostrate with ascending tips. Frequently roots where the nodes are in contact with the ground. Leaves are opposite, hairy, with rounded teeth. Lower leaves have petioles; upper leaves are without petioles and clasp the stem. Flowers are in the whorls in the axils of the upper leaves, tubular but 2-lipped, about 3/8 inch long, pinkish to purple, surrounded at the base by calyx with 5 sharp teeth. Seeds are borne 4 in a pod, sharply 3-angled, grayish-brown, about 1/16 inch long. The plant competes for space and nutrients with winter crops such as small grain.	Seeds germinate in the fall. Plants overwinter and will begin to flower during the winter if the temperature becomes fair for several days. Plants will die in the heat of summer.	A dense cover of the desired crop will minimize the competition of the weed. See Extension Bulletin 237, "Pest Control Recommendations — Field Crops" for chemical control recommendations.



MICROCOPY RESOLUTION TEST CHART
NATIONAL BUREAU OF STANDARDS 1963-A

WEED	DESCRIPTION AND DAMAGE	LIFE CYCLE	CONTROL OR MANAGEMENT PRACTICES
HORSENETTLE, Sand Brier or Wild Potato *(Solanum carolinense)*	Perennial reproducing by seed and rootstock. Stems may be branched; are hairy and spiny, 6 to 18 inches tall. Leaves are alternate and oblong. Flowers are white or mixed bluish, 5 lobed, borne in clusters. Berries are yellow skinned, juicy and contain many seeds. Berries are round until near maturity and then become wrinkled. Seeds are yellow, round and flattened.	Berries with seed fall to ground or are carried in hay to a new location; young plants develop to produce underground rootstock and new plants. In late summer plants bloom to form new berries. Found in fields, gardens, waste areas and under shrubbery. Particularly a problem in no-tillage fields.	Practice crop rotation, use of seed free of horsenettle seed and cultivate. See Extension Bulletin 237 "Pest Control Recommendations — Field Crops".
JIMSONWEED *(Datura stramonium)*	An annual reproducing by seed. Roots are thick, shallow, extensively branched. Stems are smooth, thick, erect, branching, 2 to 4 feet tall. Leaves alternate and are large, smooth, ovate with irregularly toothed edges; and have a distinctive odor. Flowers are large, funnel-shaped, white, lavender to pinkish, 2 to 5 inches long. Seed pods are about 1 inch in diameter, egg-shaped, covered with short, sharp spines. Seeds are dark brown to black, kidney-shaped, surface irregular and pitted.	Seeds germinate in spring and early summer to form plants which bloom in August and September. Seed pods rupture when mature, causing some of the seed to fall to the ground. Others are easily dispersed when the plant is bumped or cut. Found in cultivated fields, particularly soybean, feed lots and certain waste areas.	Use clean seed and practice cultivation and clipping of waste areas. See Extension Bulletin 237 "Pest Control Recommendations — Field Crops".
JOHNSONGRASS *(Sorghum halepense)*	A noxious weed. Perennial reproducing by rhizomes and seed. Similar to sudangrass. Root system is extensive, fibrous with large, coarse rhizomes. Rhizomes are mostly white but can be reddish or purple with purple spots and scales at each node. Stems are erect, coarse, from 1 to 8 feet tall. Leaves are smooth, alternate 6 to 20 inches, about ½ to 1½ inches wide. Panicles are large, somewhat open, purplish and with short awns. Seeds are oval, reddish-brown, marked with fine lines on the surface.	Seed germinates from late spring to late summer, forming rhizomes in about 5 weeks which overwinter and send up new plants from the nodes. Seed heads are produced from summer to fall. Seeds are carried by equipment and in seed lot. Rhizomes may be carried on tillage equipment.	Use clean seed and good cultural practices. Mow to prevent seed head formation. Clean harvesting and tillage equipment of seed and rhizomes. See Agronomy Mimeo 65 for chemical control programs.

WEED	DESCRIPTION AND DAMAGE	LIFE CYCLE	CONTROL OR MANAGEMENT PRACTICES
KNAWEL *(Scleranthus annus)*	A winter annual reproducing by seed with short slender stems that are somewhat rough. Many branches, spreading with leaves subulate. Flowers are greenish and clustered. Seeds are many and small.	Seeds germinate in fall and early winter; flowers and sets seed in late spring and early summer. Found in small grain fields, lawns, flower beds, gardens, roadside and waste areas especially heavy in coastal plain region.	Crop rotation can prevent seed development. See Extension Bulletin 237 "Pest Control Recommendations — Field Crops".
NIMBLEWILL *(Muhlenbergia schreberi)*	Perennial reproducing by seed and fine stolons. Stems smooth, slender, spreading and branching, decumbent at base with rooting at nodes. Leaves are flat and short with a few marginal hairs at the leaf base, short membranous ligule, smooth collar and loose leaf sheath. Seed head is a slender panicle, 2 to 6 inches long, appearing in late summer. Seeds are very small; found in lawns, pastures and noncrop land. Often confused with other grasses such as bermudagrass.	Plants overwinter and seeds germinate in spring. Plant develops slowly to where it may cover a square foot. Produces many small seeds in August and September. Spreads rapidly by stolons and seeds.	Practice crop rotation and consult chemical controls listed in Agronomy Mimeo 71, "Bermudagrass, Quackgrass, Nimblewill and Bentgrass Control in Turf".
QUACKGRASS *(Agropyron repens)*	Perennial reproducing by seed and rhizomes. Rhizomes vary from 2 to 8 inches in depth in the soil and are about ⅛ inch in diameter. Stems are 1½ to 3 feet tall, with smooth culms and three to six joints. Leaves have auricles, ligule measures 1/32 inch long, hairy lower sheaths, upper sheaths glabrous or nearly so. Spike has three to seven short-awned florets in a spikelet. The plant is a severe competitor for plant nutrients; the rhizomes can damage potato tubers by penetrating them.	Seeds germinate in late spring and can flower by summer; rhizomes are generated by midsummer. Plants arising from rhizomes will be actively growing in the fall, overwinter and begin growth early in the spring or late winter. Individual rhizomes live only two summers and one winter. Roots arise only at nodes of the rhizomes.	To control quackgrass the rhizomes must be killed, and to do this the growth of leaves must be prevented. In small areas this can be done by smothering them with tar paper, boards, straw or other material. In larger areas it can be pastured with hogs, plowed and thoroughly harrowed with a spiked tooth harrow, or subjected to crop rotation and the use of special cultivating equipment. No matter what method is used, the rhizomes must be starved. Chemicals that will help in its control are listed in Extension Bulletin 237, "Pest Control Recommendation — Field Crops".

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WEED	DESCRIPTION AND DAMAGE	LIFE CYCLE	CONTROL OR MANAGEMENT PRACTICES
REDROOT PIGWEED *(Amaranthus retroflexus)*	An annual reproducing by seed. Taproot is shallow and red. Stems are erect, 1 to 6 feet tall; rough, maybe branching if no competition. Leaves are dull green, long petioles. Flowers are green, small in dense panicles in upper leaf axils and at top end of stem. Each flower is surrounded by three spiny bracts; seeds are small, shiny, black and lens-shaped.	Seeds germinate from spring to early summer producing flowers in late summer to early fall. Seeds fall to ground or are carried in crop seed through harvest. Each plant produces numerous seeds. Found in cultivated fields, yards, gardens, fence rows and waste areas.	Use clean seed and practice crop rotation and cultivation. See Extension Bulletin 237 "Pest Control Recommendations — Field Crops".
SMARTWEED *(Polygonum spp.)*	There are several species of smartweed. The most troublesome and widespread are annuals (i.e.: *Polygonum pensylvanicum* or Pennsylvania smartweed and *P. persicaria* or Ladysthumb). Stems are smooth, swollen at nodes and branching, 1 to 4 feet tall. The leaves are smooth, pointed and alternate, 2 to 6 inches long with a sheath at the base extending around the stem. Flowers are bright pink or rose, five-parted, arranged in a short spike. Seeds are shiny, black and smooth, flattened, almost circular.	Seeds germinate in the spring to early summer. Flowering occurs midsummer to frost with seeds being produced shortly after flowering. Found in cultivated ground and waste places and along ditches.	Crop rotation, hoeing, cultivation and chemicals. See Extension Bulletin 237 "Pest Control Recommendations — Field Crops".
VELVETLEAF, COTTONWEED *(Abutilon theophrasti)*	An annual reproducing by seed with strongly developed taproot and stem. Stem is smooth, often 6 to 8 feet tall, and is covered with short velvety hairs. Leaves are large, heart-shaped, pointed, alternate and with a soft, velvety, hairy surface. Flowers are about ¾ inch in diameter with 5 yellow petals borne on a short stalk attached to the leaf axils on the upper-part of the stem. Seed pod is cup-shaped, about 1 inch in diameter with a ring of prickles about the upper edge. Seeds are grayish-brown, flattened, notched and about ⅛ inch long.	Seeds germinate in the spring to early summer. Flowering occurs in midsummer with seeds formed in late August till frost. Found principally in soybean and corn fields but occasionally in gardens, fence rows and waste areas.	Practice rotation of crops, hoeing, cultivation techniques and chemical control. See Extension Bulletin 237 "Pest Control Recommendations — Field Crops".

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WEED	DESCRIPTION AND DAMAGE	LIFE CYCLE	CONTROL OR MANAGEMENT PRACTICES
WILD GARLIC WILD ONION *(Allium vineale),* *(Allium canadense)*	Both are perennials, reproducing by seed, aerial bulbets and underground bulbets. Only wild garlic has hard shell, underground bulbets which can remain dormant for several years; both species have soft shell bulbets which do not possess any dormancy. The aerial bulbets ripen at about the same time as winter wheat and are harvested with them. Wild garlic is the predominant species. The plants are similar to each other; the following is a comparison of the two species. Wild garlic leaves are cylindrical in form and sometimes originate on the stem above ground. Bulbs are produced in clusters at the plant base, have a fibrous covering and may be hard-shelled (brown) or soft-shelled. Flavor and odor are strong. Wild onion has a flat leaf that originates at ground level, out of the bulb. It has a single soft-shelled bulb with a netlike covering. Flavor and odor are moderate.	Plants emerge and form seeds or bulbets in the fall. With wild garlic, the hard shell bulbets must overwinter before germination or they may lie dormant for 2 or more years. Emerged plants overwinter and begin growth in the spring. Aerial bulbets about the size of kernels of wheat are formed at the tips of the slender, hollow leaves.	Use cultural control, consisting of late fall plowing with a cultivated crop during the summer growing season. See Agronomy Mimeo 22, "Control Wild Garlic in Small Grains and Pastures".
BIRDSRAPE MUSTARD Wild Turnip *(Brassica rapa)*	An annual or biennial reproducing by seed. Leaves are opposite, moderately long and narrow. The leaves are bristly and deep green. Flowers are deep yellow and small. Seeds are round and contained in long pods. A problem in small grain and particularly in alfalfa. The stem is a rosette in fall and winter. Spring flowering brings 1- to 3-foot flower stalk. Root is bulblike, similar to garden turnip.	Seeds germinate in late summer and fall, overwinter as small turnip-like plants. Stems elongate in spring to form flower and seed head. Seeds ripen in June.	Crop rotation prevents seed development and recommended chemical controls are listed in Extension Bulletin 237 "Pest Control Recommendations—Field Crops".

WEED	DESCRIPTION AND DAMAGE	LIFE CYCLE	CONTROL OR MANAGEMENT PRACTICES
YELLOW NUTSEDGE *(Cyperus esculentus)*	Perennial reproducing by seed and tubers. Roots are fibrous, bearing small nut-like tubers at the tips. Stems are erect, triangular and yellow-green. Leaves are three-ranked and narrow. Flowers are yellowish or yellowish-brown. Seeds are yellowish-brown, small and angular.	Vigorous plants arise from tubers. Seed germination is thought to be sparse; seeds germinate in the spring. Mature plants produce the nut-like tubers and a seed head. Found in cultivated fields, pastures and lawns, especially in low areas.	Use crop rotation, cultivation and clipping to prevent seed development. See Extension Bulletin 237 "Pest Control Recommendations — Field Crops".
YELLOW ROCKET *(Barbarea vulgaris)*	Winter annual, but can also be a biennial, reproducing by seed. Stems are numerous, growing upright from a crown, 1 to 2 feet tall, branching near top, smooth and angular or ridged. Leaves are pinnately divided. Basal leaves have a large terminal lobe, are 2 to 8 inches long and form a dense rosette; stem leaves become progressively shorter with top leaves about 1 inch long and less deeply lobed. Flowers are bright lemon, 4-petaled (typical mustard flower), borne in spikelike racemes on the end of each branch. Seeds are light yellow to yellowish-brown and 1/32 inch long.	Seeds germinate in late summer or fall. Plants overwinter and begin to bloom in April and continue to blossom and form seeds for about 3 months. It can be found in grain fields, grass fields and legume or legume-grass hay fields.	Crop rotation can be used to reduce the amount of seed. The longevity of the seeds means that the weed will not be eliminated, only the number of surviving seeds will be reduced. Chemical control in alfalfa is not possible.

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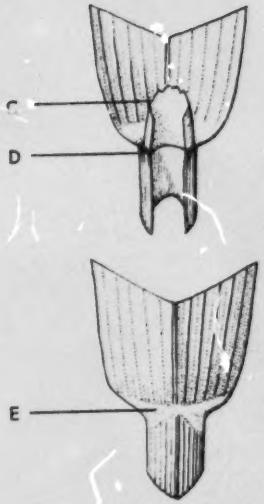

ANNUAL BLUEGRASS

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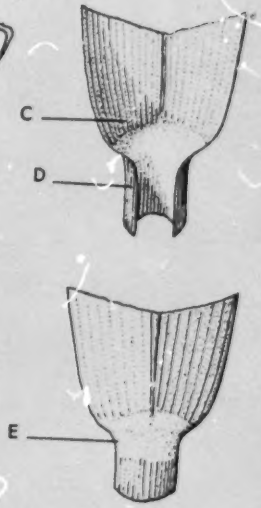

BARNYARDGRASS

Drawings courtesy of Jim Converse and O. M. Scott and Sons.

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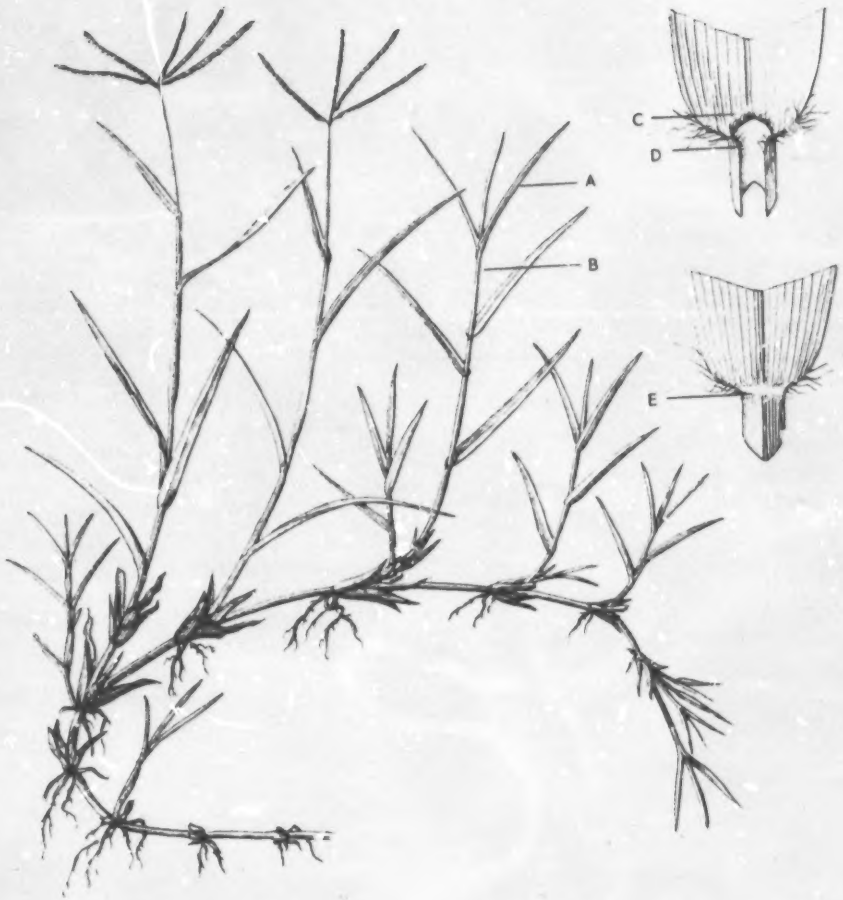
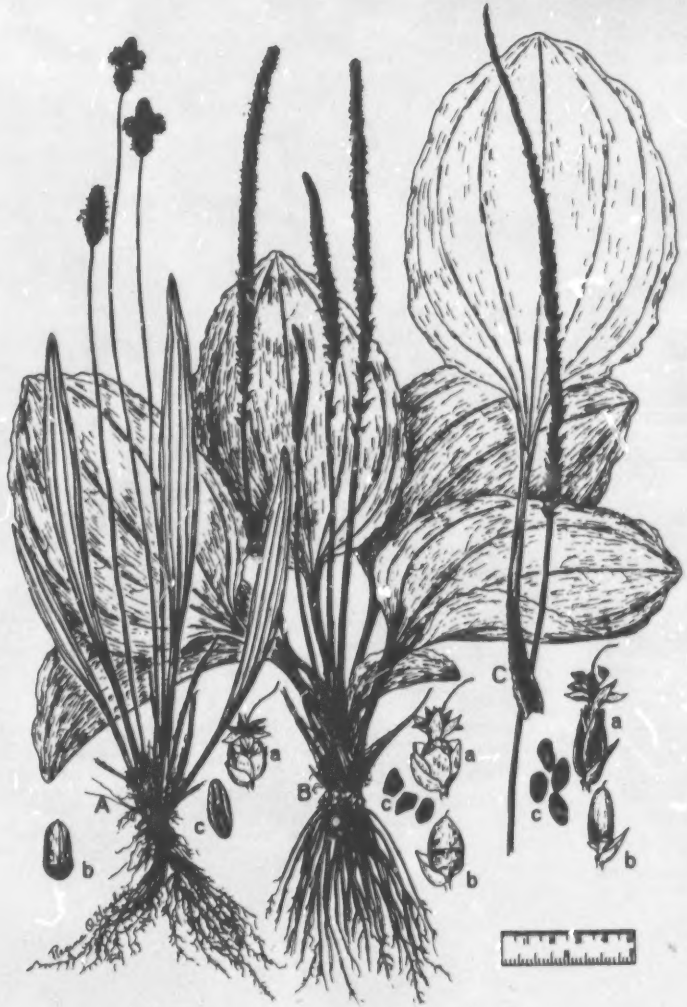


BERMUDAGRASS

Drawing courtesy of Jim Converse and O. M. Scott and Sons.



Habit for all—× 0.5. *A*, *Plantago lanceolata* L. Buckhorn plantain. *a*, Flower—× 2.5; *b*, capsule—× 3; *c*, seed—× 5. *B*, *Plantago major* L. Broadleaf plantain. *a*, Flower—× 2.5; *b*, capsule—× 3; *c*, seeds—× 5. *C*, *Plantago rugelii* Decne. Blackseed plantain. *a*, Flower—× 2.5; *b*, capsule—× 2.5; *c*, seeds—× 3.

BUCKHORN PLANTAIN

Drawing courtesy of Agricultural Research Service, U.S. Department of Agriculture.

Cirsium arvense (L.) Scop. Canada thistle. *A*, Habit—× 0.5; *B*, head—× 1; *C*, flower—× 2.5; *D*, achene—× 3.

CANADA THISTLE
Drawing courtesy of Agricultural Research Service, U.S. Department of Agriculture.

CHICKWEED
Drawing courtesy of Jim Converse and O. M. Scott and Sons.

Xanthium pensylvanicum Wallr. Common cocklebur. *A*, Habit—× 0.5; *B*, seedling—× 0.5; *C*, bur—× 1.25; *D*, seed—× 1.5.

Chenopodium album L. Common lambsquarters. *A*, Habit, small plant; *B*, floral spike—× 2.5; *C*, flowers—× 7.5; *D*, utricle—× 4; *E*, seed—× 4.

COCKLEBUR

COMMON LAMBSQUARTERS

Drawings courtesy of Agricultural Research Service, U.S. Department of Agriculture.

Ipomoea purpurea (L.) Roth. Tall morningglory. *A*, Habit—× 0.5; *B*, flower diagram—× 0.5; *C*, capsule—× 0.5; *D*, seeds—× 3.

COMMON MORNINGGLORY

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Ambrosia artemisiifolia L. Common ragweed. *A*, Habit—× 0.5; *B*, raceme with male heads (*above*) and female involucres (*below*)—× 2.5; *C*, leaf variations—× 0.75; *D*, achene—× 5; *E*, seed—× 5.

COMMON RAGWEED

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Drawings courtesy of Agricultural Research Service, U.S. Department of Agriculture.

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Anthemis cotula L. Mayweed. *A*, Habit—× 0.5; *B*, enlarged leaf—× 2; *C*, flower head—× 1.5; *D*, disk flower—× 8; *E*, achenes—× 8.

CORN CHAMOMILE, MAYWEED

Drawing courtesy of Agricultural Research Service, U.S. Department of Agriculture.

CORN-COCKLE

CRABGRASS 117

DANDELION

Drawings courtesy of Jim Converse and O. M. Scott and Sons.

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F & F 7

Rumex crispus L. Curly dock. *A*, Habit—× 0.5; *B*, Fruit, *a*, surrounded by persistent calyx, *b*, showing 3 valves—× 3.5; *C*, achene—× 5.

DOCK, CURLY

Drawing courtesy of Agricultural Research Service,
U.S. Department of Agriculture.

DODDER

Panicum dichotomiflorum Michx. Fall panicum. *A*, Habit—× 0.5; *B*, spikelet, showing the dichotomous florets—× 7.5; *C*, ligule—× 4; *D*, caryopses—× 7.5.

Convolvulus arvensis L. Field bindweed. *A*, Habit—× 0.5; *B*, rootstock—× 0.5; *C*, leaf variation —× 0.5; *D*, flower, showing 5 stamens of unequal length—× 1; *E*, capsule—× 3; *F*, seeds—× 4.

FALL PANICUM

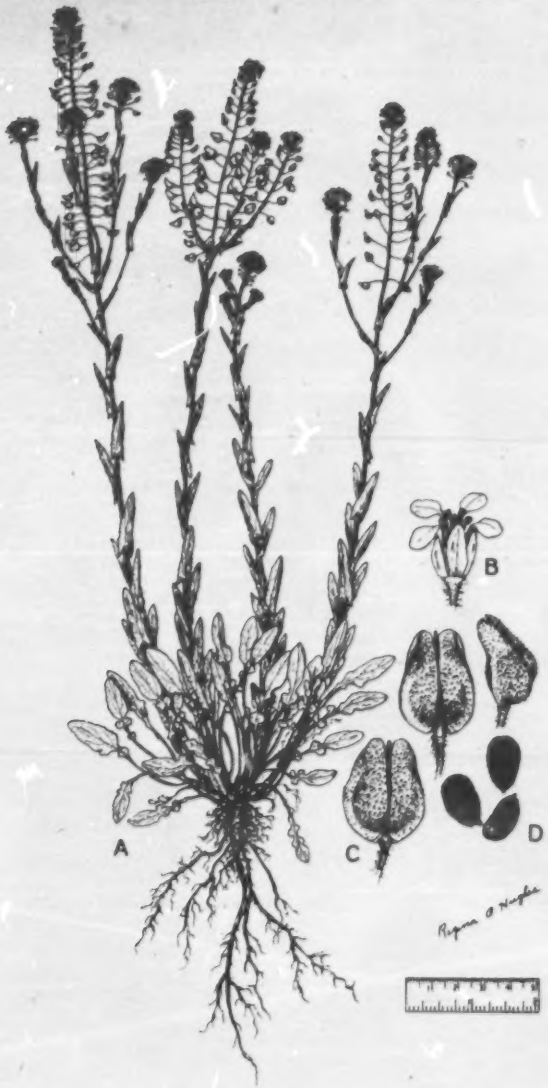
121

FIELD BINDWEED

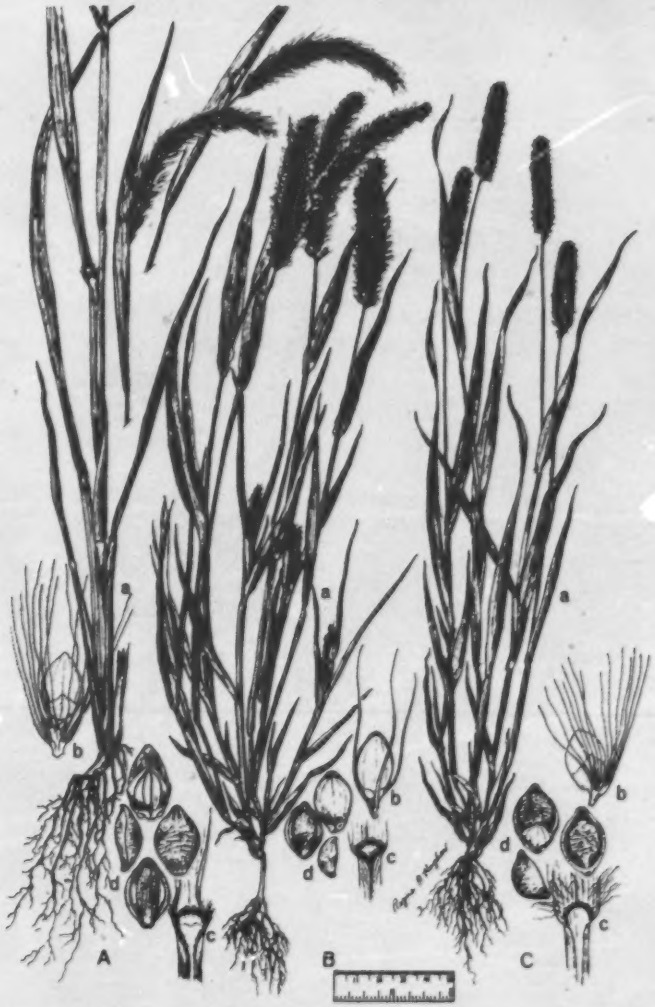
Drawings courtesy of Agricultural Research Service, U.S. Department of Agriculture.

F & F 9

122



Lepidium campestre (L.) R. Br. Field pepperweed *A*, Habit—× 0.5; *B*, flower—× 7.5; *C*, silicles —× 4; *D*, seeds—× 5.



A, *Setaria faberi* Herrm. Giant foxtail. *a*, Habit—× 0.5; *b*, spikelet, showing subtending bristles —× 5; *c*, ligule—× 1.5; *d*, caryopses—× 5. *B*, *Setaria viridis* (L.) Beauv. Green foxtail. *a*, Habit—× 0.5; *b*, spikelet—× 5; *c*, ligule—× 1.5; *d*, caryopses—× 5. *C*, *Setari glauca* (L.) Beauv. Yellow foxtail. *a*. Habit— × 1; *b*, spikelet—× 5; *c*, ligule—× 1.5; *d*, caryopses—× 5.

FIELD PEPPERGRASS

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FOXTAIL

Drawings courtesy of Agricultural Research Service, U.S. Department of Agriculture.

F & F 10

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Apocynum cannabinum L. Hemp dogbane. *A*, Habit—× 0.5; *B*, rootstock—× 0.5; *C*, flowers—× 5; *D*, follicles—× 0.5; *E*, seed with coma—× 1; *F*, seeds—× 5.

Lamium amplexicaule L. Henbit. *A*, Habit—× 0.5; *B*, flower clusters, showing very short upper internodes—× 1.5; *C*, calyx surrounding nutlets—× 4; *D*, nutlets—× 7.5.

HEMP DOGBANE

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HENBIT

Drawings courtesy of Agricultural Research Service, U.S. Department of Agriculture.

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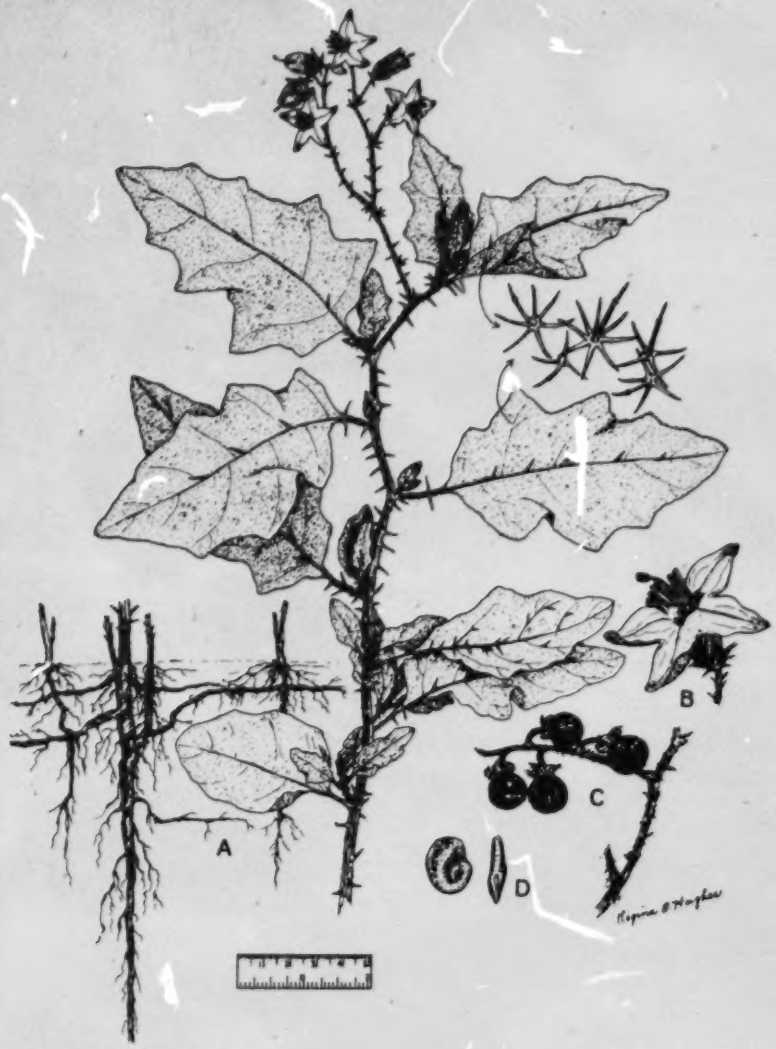
F 11



Solanum carolinense L. Horsenettle. *A*, Habit—× 0.5; *B*, flower—× 1.5; *C*, berries—× 0.5; *D*, seeds—× 5.

Datura stramonium L. Jimsonweed. *A*, Habit, upper part of plant—× 0.5; *B*, cauline leaf—× 0.5; *C*, ripe capsule—× 0.5; *D*, seeds—× 3.

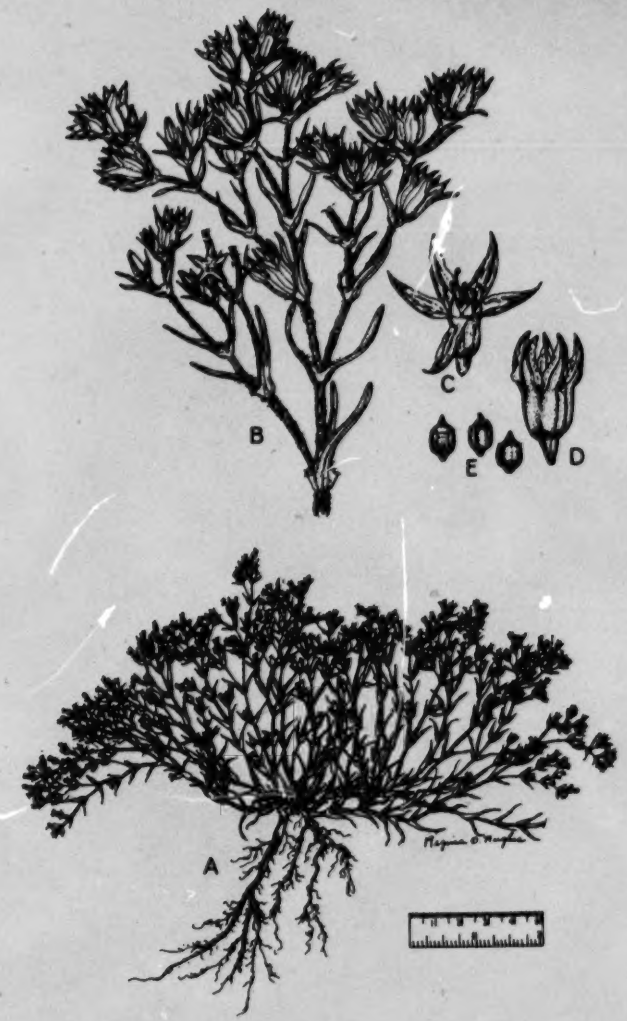
HORSENETTLE

JIMSONWEED

Drawings courtesy of Agricultural Research Service, U.S. Department of Agriculture.

F & F 12

JOHNSONGRASS 129



Scleranthus annuus L. Knawel. *A*, Habit—× 0.5; *B*, enlarged branch—× 2.5; *C*, flower—× 5; *D*, fruit (utricle, 1-seeded)—× 5; *E*, seeds—× 5.

KNAWEL

Drawing courtesy of Agricultural Research Service, U.S. Department of Agriculture

F & F 13

130

NIMBLEWILL

Drawing courtesy of Jim Converse and O. M. Scott and Sons.

131

Agropyron repens (L.) Beauv. Quackgrass. *A*, Habit—× 0.5; *B*, spikelet—× 3; *C*, ligule—× 2.5; *D*, florets—× 3.25.

QUACKGRASS

Drawing courtesy of Agricultural Research Service, U.S. Department of Agriculture.

F1&F2 14

132

Amaranthus retroflexus L. Redroot pigweed. *A*, Habit—× 0.5; *B*, pistillate spikelet—× 5;] *C*, utricle—× 5; *D*, seeds—× 3.

Polygonum pensylvanicum L. Pennsylvania smartweed. *A*, Habit—× 0.5; *B*, spike—× 2.5; *C*, achenes—× 4.

REDROOT PIGWEED

SMARTWEED

133

Drawings courtesy of Agricultural Research Service, U.S. Department of Agriculture.

F & F 15

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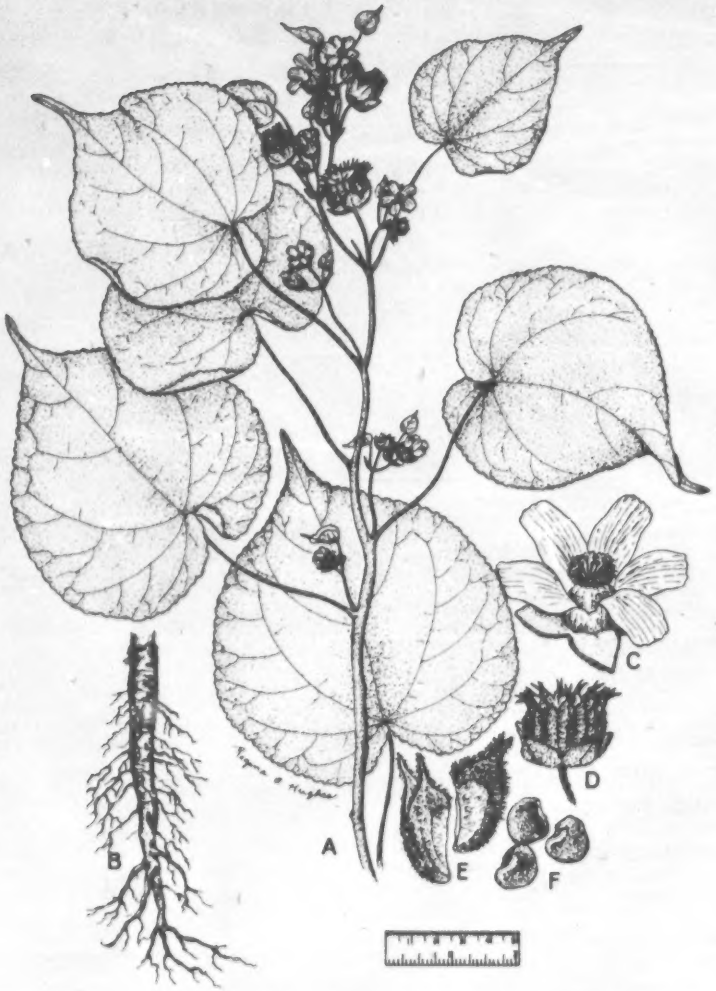
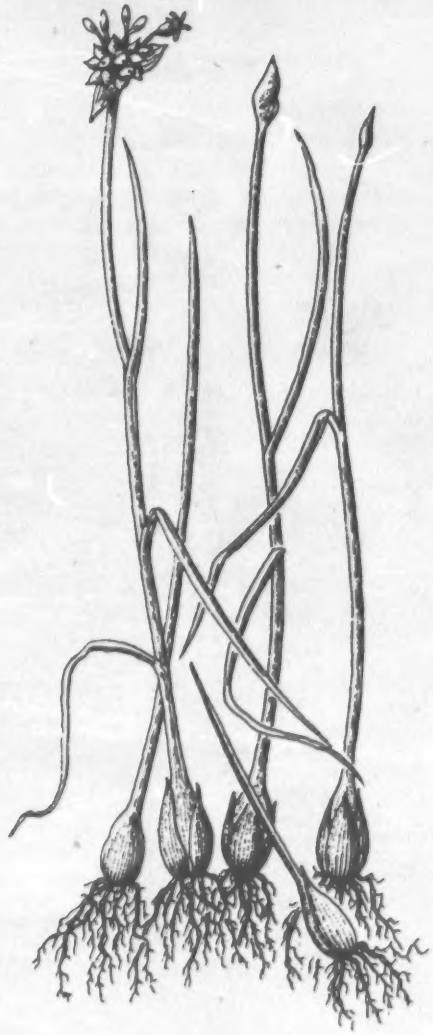


Abutilon theophrasti Medic. Velvetleaf. *A*, Habit—× 0.5; *B*, rootstock—× 0.5; *C*, flower—× 2.25; *D*, capsule—× 1; *E*, carpels—× 1.5; *F*, seeds—× 4.5.

VELVETLEAF

Drawing courtesy of Agricultural Research Service, U.S. Department of Agriculture.



WILD GARLIC

Drawing courtesy of Jim Converse and O. M. Scott and Sons.

F & F 16

Cyperus esculentus L. Yellow nutsedge. *A*, Habit—× 0.5; *B*, spikelet—× 5; *C*, achene—× 10.

Barbarea vulgaris R. Br. Yellow rocket. *A*, Habit—× 0.5; *B*, flower—× 2.5; *C*, raceme of fruits—× 0.5; *D*, silique—× 2; *E*, seeds—× 5.

YELLOW NUTSEDGE

YELLOW ROCKET

Drawings courtesy of Agricultural Research Service, U.S. Department of Agriculture.